ConneXium

Ethernet Cabling System
TCSESM Managed Switch
Configuration Manual

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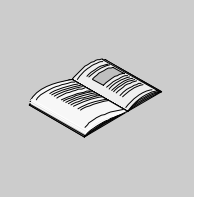

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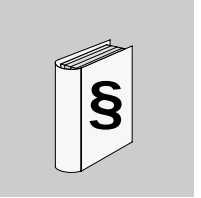
Safety Information



Important Information

NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a Danger or Warning safety label indicates that an electrical hazard exists, which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER

DANGER indicates an imminently hazardous situation, which, if not avoided, **will result** in death or serious injury.

⚠ WARNING

WARNING indicates a potentially hazardous situation, which, if not avoided, **can result** in death, serious injury, or equipment damage.

⚠ CAUTION

CAUTION indicates a potentially hazardous situation, which, if not avoided, **can result** in injury or equipment damage.

PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

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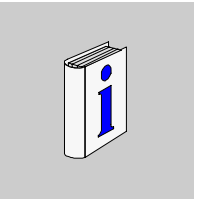
About the Book



At a Glance

Document Scope

The Schneider Electric ConneXium Industrial Ethernet Offer is comprised of a complete family of products and tools required to build the infrastructure of an Industrial Ethernet network.

The offer includes:

- switches, hubs, and transceivers
- gateways
- cables, connectors, and accessories

This manual contains a device description, safety instructions, technical data and all the other information you need to install the ConneXium ESM Ethernet switches before you start configuring them. This manual contains all the information you need to choose and configure a ConneXium ESM Ethernet switch.

Validity Note

The data and illustrations found in this book are not binding. We reserve the right to modify our products in line with our policy of continuous product development. The information in this document is subject to change without notice and should not be construed as a commitment by Schneider Electric.

Related Documents

Title of Documentation	Reference Number
ConneXium Ethernet Cabling System Managed Switch Redundancy Manual	31007126
ConneXium Ethernet Cabling System Managed Switch Command Line Interface	31007130
ConneXium Ethernet Cabling System Managed Switch Installation Manual	31007118

Product Related Information

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All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to ensure compliance with documented system data, only the manufacturer should perform repairs to components.

When devices are used for applications with technical safety requirements, please follow the relevant instructions.

Failure to use Schneider Electric software or approved software with our hardware products may result in improper operating results.

Failure to observe this product related warning can result in injury or equipment damage.

User Comments

We welcome your comments about this document. You can reach us by e-mail at techpub@schneider-electric.com

The User Interfaces

1

The System Monitor

Features of the System Monitor

The System Monitor enables you to:

- select the boot operating system
- update the operating system
- start the selected operating system
- end the System Monitor
- erase the saved configuration
- show the boot code information

Data Transfer Parameters

The following table shows the data transfer parameters.

Parameter	Value or Status
Speed	9600 baud
Data	8 bit
Parity	none
Stopbit	1 bit
Handshake	off

Opening the System Monitor

Open the System Monitor as follows:

Step	Action	Comment
1	Using a terminal cable, connect the V.24 RJ11 socket to ● either a terminal ● or a COM port of a PC with terminal emulation according to VT 100	The V.24 interface of the switch supports the baud rates 9600 and 19200 (default setting: 9600). For the physical connection refer to the *Installation User Manual*.
2	Start the terminal program on the PC, and establish a connection with the switch.	While the ESM is booting, the following message appears on the terminal: Press <1> to enter System Monitor 1...
3	Type `1` within one second to start System Monitor 1.	Subsequently, System Monitor 1 displays the following information: **1.** Select Boot Operating System **2.** Update Operating System **3.** Start Selected Operating System **4.** End (reset and reboot) **5.** Erase main configuration file **6.** Show Bootcode Information
4	Select the desired menu by typing its number.	
5	To leave a submenu and to return to the main menu of the System Monitor, press **ESC**.	

The Command Line Interface (CLI)

Features of the CLI

The CLI allows you to

- use all device functions via a local or remote connection
- provides you with a familiar environment for configuring IT devices
- feed several devices with identical configuration data, due to its script ability

For a detailed description of the CLI, refer to the reference guide *Command Line Interface*.

Interfaces to Access the CLI

The CLI can be accessed using

- the V.24 port (out-of-band) or
- Telnet (in-band).

Abbreviating Keywords

In the CLI, you can abbreviate keywords as follows:

Step	Action	Comment
1	Type the first letters of the keyword.	
2	Press the TAB key.	The command line interface adds the remaining letters for you.

Opening the CLI

Open the CLI as follows:

Step	Action	Comment
1	Connect the device via the V.24 interface to ● a terminal ● or to a COM port of a PC with terminal emulation according to VT 100 using a serial cable, and press any key (*p. 12*), or start the CLI using Telnet.	A window in which you are asked to enter your user name appears on the screen. (A maximum of five users are permitted to access the CLI).
2	Type a user name.	The default setting for the user name is admin. You can change the user name later in the CLI. These entries are case sensitive.
3	Press the ENTER key.	
4	Type the password.	The default setting for the password is private. You can change the password later in the CLI. These entries are case sensitive.
5	Press the ENTER key.	

The Web-Based Interface

Requirements

To open the Web-based interface, you will need a Web browser (a program that can read hypertext), for example, Netscape Navigator/Communicator version 6.0 or higher or Microsoft Internet Explorer version 5.5 or higher.

Enabling the Web-Based Interface

The following table shows the steps to enable the Web-based interface.

Step	Action	Comment
1	Connect the ESM switch to an Ethernet cable.	
2	Start your Web browser.	
3	Make sure that Java Script is active on your browser.	
4	Establish the connection by entering the IP address of the switch with which you want to administer the Web-based network management in the address field of the Web browser. Enter the address in the following form: `http://xxx.xxx.xxx.xxx`	The Web-based interface uses the plug-in Java™ runtime environment version 1.4. x, 1.5 x or 1.6. x If this is not installed on your computer, an installation via the Internet starts automatically the first time you start the Web-based interface. If your computer is not connected to the Internet, or you do not have access to the Java plug-in, install the version on the enclosed CD-ROM. **For NT users and computers not connected to the Internet**: Cancel the installation and install the plug-in from the enclosed CD-ROM. Start the program file **j2re1_4_0-win-i.exe** in the *Java* directory on the CD-ROM.

Login Screen

The figure below shows the login window.

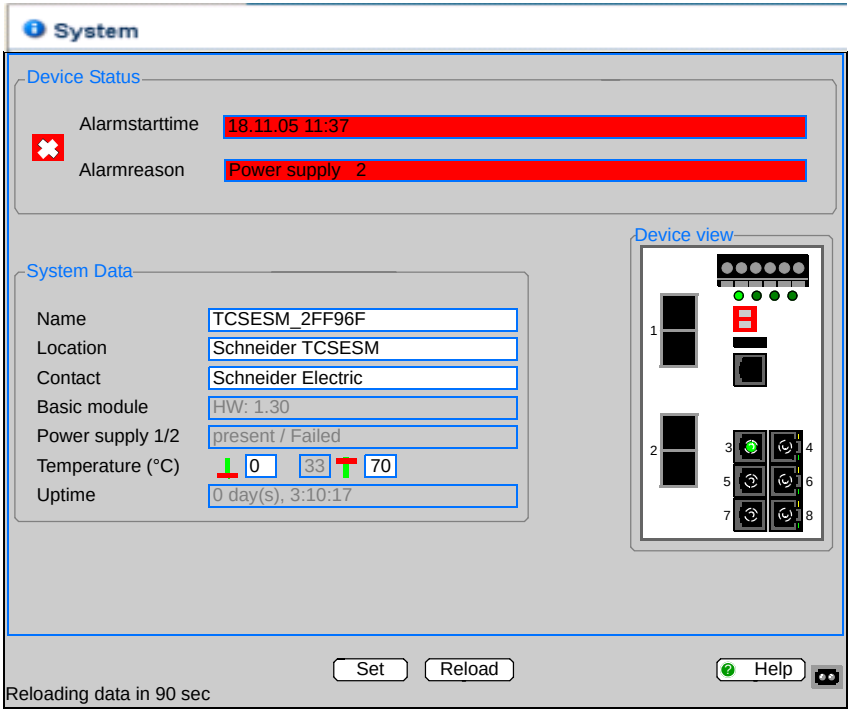
Logging In

Log in as follows:

Step	Action	Comment
1	Select the desired language.	Choose english or german.
2	In the login pull-down menu, select either user or admin access to access the switch.	user: read access admin: read and write access
3	For read permission, enter the password public. For read/write permission, enter the password private (default setting).	Change the password from these default settings to protect the switch against unauthorized access.
4	Click OK.	The system screen appears.

System Screen

The figure shows the system screen of the ESM switch.



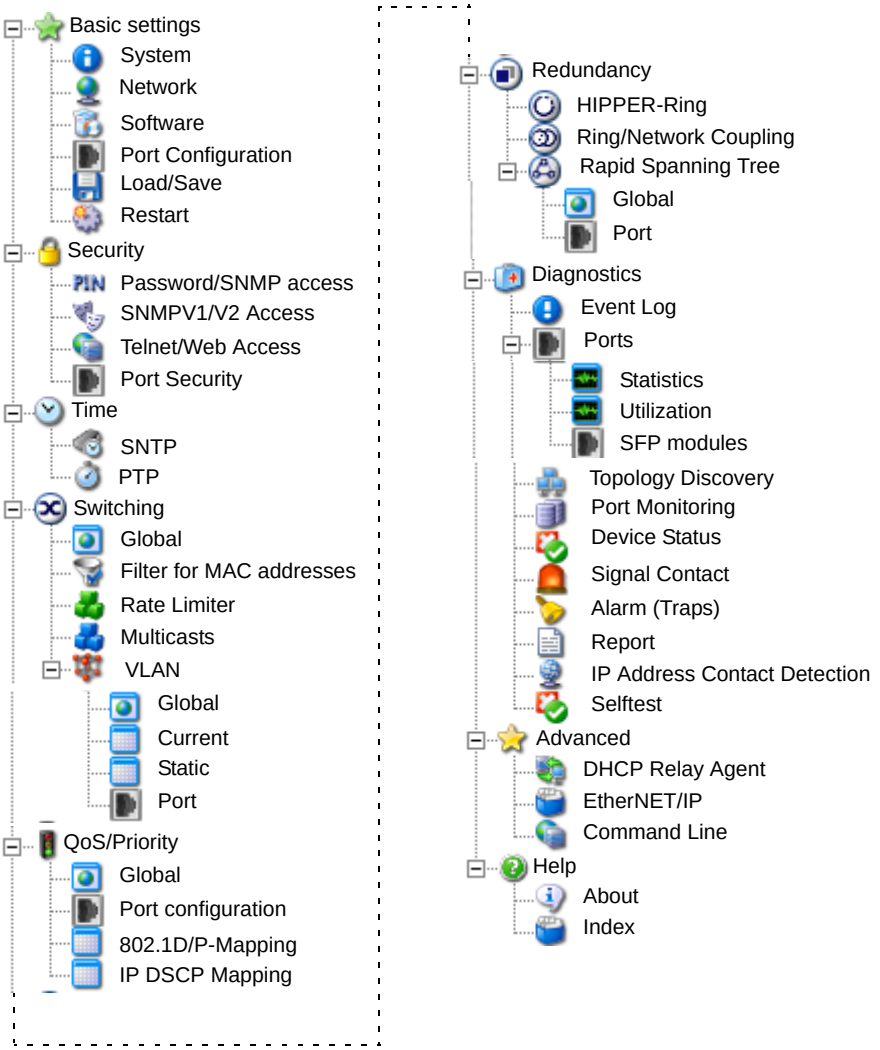
The Set and Reload Buttons

The table explains the Set and Reload buttons.

Set	Reload
Click the Set button to apply the changes you have made to the dialogs.	Click the Reload button to update the system screen.

The Tree View

The figure below shows the tree view of the Web-based interface. All path references in the manual refer to this tree view. For example: Go to Basics, System.



Entering the IP Parameters

2

Basics of the IP Parameters

Background Information concerning the IP Address

The IP address is used for the configuration of the ESM. The IP address background information is discussed here.

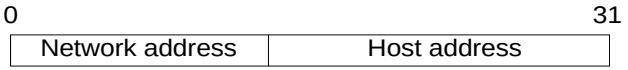
The IP addresses consist of four bytes. These four bytes are written in decimal notation, each separated by a dot. Five classes of IP addresses were defined in RFC 790 (1992). The most frequently used address classes are A, B and C.

The following table describes IP address classification.

Class	Net Address	Host Address	Address Range
A	1 byte	3 bytes	1.0.0.0 to 126.255.255.255
B	2 bytes	2 bytes	128.0.0.0 to 191.255.255.255
C	3 bytes	1 bytes	192.0.0.0 to 223.255.255.255
D			224.0.0.0 to 239.255.255.255
E			240.0.0.0 to 255.255.255.255

The network address, assigned by ARIN (American Registry for Internet Numbers), represents the fixed part of the IP address.

The following figure shows the bit notation of the IP address.

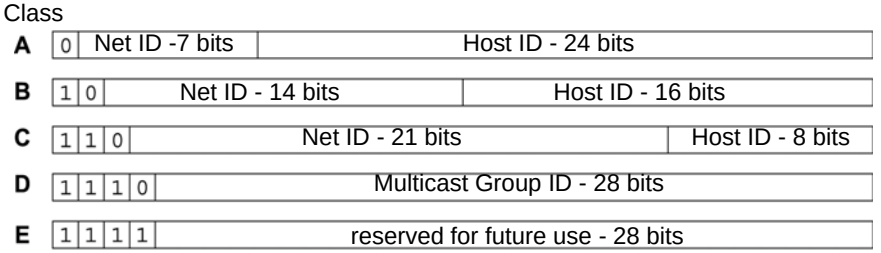


The network address represents the fixed part of the IP address. The worldwide leading regulatory board for assigning Internet addresses is the IANA (Internet Assigned Numbers Authority). If you need an IP address block, contact your Internet service provider. Internet service providers should contact their local higher level organization:

- APNIC (Asia Pacific Network Information Centre): Asia/Pacific region
- DARIN (American Registry for Internet Numbers): Americas and Sub-Sahara Africa

- LACNIC (Regional Latin-American and Caribbean IP Address Registry): Latin America and some Caribbean Islands
- RIPE NCC (Réseaux IP Européens): Europe and Surrounding Regions

The bit representation of the IP address is shown in the following figure.



All IP addresses belong to class A when their first bit is a zero, i.e., the first decimal number is 126 or less.

The IP address belongs to class B if the first bit is 1 and the second bit is 0, i.e., the first decimal number is between 128 and 191.

The IP address belongs to class C if the first two bits are a 1, i.e., the first decimal number is higher than 191.

Assigning the host address (host ID) is the responsibility of the network operator, who is solely responsible for the uniqueness of the assigned IP addresses.

Network Mask

Routers and gateways subdivide large networks into subnetworks. The network mask assigns the individual devices to particular subnetworks.

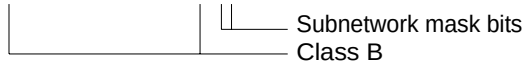
The subdivision of the network into subnetworks is performed in much the same way as IP addresses are divided into classes A to C (net ID).

The bits of the host address (host ID) that are to be shown by the mask are set to one. The other host address bits are set to zero in the network mask (see the following example).

The following figure shows an example of a network mask.

Decimal notation
255.255.192.0

Binary notation
11111111.11111111.11000000.00000000



The following figure shows an example of IP addresses with subnetwork allocation in accordance with the network mask from the above example.

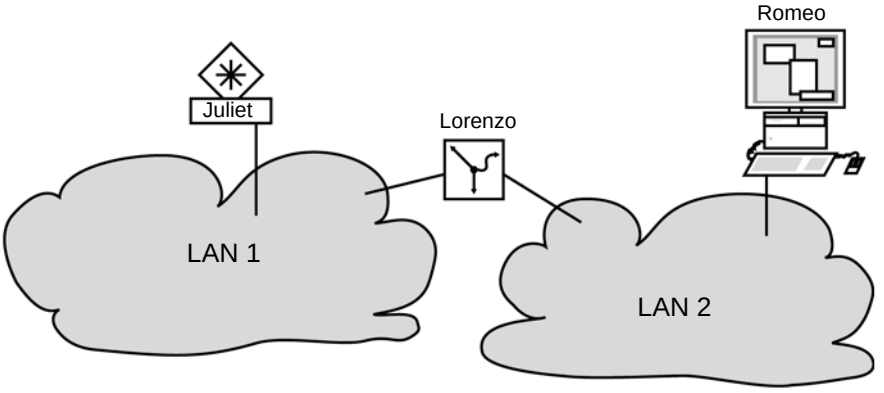
Decimal notation
129.218.65.17
└──── 128 < 129 ≤ 191 → Class B
binary notation
10000001.11011010.01000001.00010001
└──────────────────────────────────── Network address
└──────────────────────────────── Subnetwork 1

Decimal notation
129.218.129.17
└──── 128 < 129 ≤ 191 → Class B
binary notation
10000001.11011010.10000001.00010001
└──────────────────────────────────── Network address
└──────────────────────────────── Subnetwork 2

Example of Network Mask Usage

In a large network it is possible that gateways and routers separate the management card from its management station. How does addressing work in such a case?

The figure below shows a management agent that is separated from its management station by a router.



Sending Data

The management station *Romeo* wants to send data to the management agent *Juliet*. Romeo knows Juliet's IP address and also knows that the router *Lorenzo* knows the way to Juliet.

Example

Romeo therefore puts his message in an envelope and writes Juliet's IP address on the outside as the destination address. For the source address he writes his own IP address on the envelope.

Romeo then places this envelope in a second one with Lorenzo's MAC address as the destination and his own MAC address as the source. This process is comparable to going from layer three to layer two of the ISO/OSI base reference model.

Finally, Romeo puts the entire data packet into the mailbox. This is comparable to going from layer two to layer one, i.e., to sending the data packet over the Ethernet.

Lorenzo receives the letter and removes the outer envelope. From the inner envelope he recognizes that the letter is meant for Juliet. He places the inner envelope in a new outer envelope and searches his address list (the ARP table) for Juliet's MAC address. He writes her MAC address on the outer envelope as the destination address and his own MAC address as the source address. He then places the entire data packet in the mail box.

Juliet receives the letter and removes the outer envelope, exposing the inner envelope with Romeo's IP address. Opening the letter and reading its contents corresponds to transferring the message to the higher protocol layers of the ISO/OSI layer model.

Juliet would now like to send a reply to Romeo. She places her reply in an envelope with Romeo's IP address as destination and her own IP address as source. The question then arises, where should she send the letter, since she did not receive Romeo's MAC address. It was lost when Lorenzo replaced the outer envelope.

In the MIB, Juliet finds Lorenzo listed under the variable aNetGateway → IPAddr as a means of communicating with Romeo. The envelope with the IP addresses is therefore placed in a further envelope with the MAC destination address of Lorenzo.

The letter then travels back to Romeo via Lorenzo, in the same manner that the first letter traveled from Romeo to Juliet.

Configuring the ESM using the Command Line Interface

General Information Concerning the Configuration via CLI

Choose the CLI method if

- you preconfigure your switch outside its operating environment, or
- if you have no network access to the switch.

Note: If there is no terminal or PC with terminal emulation available in the vicinity of the installation location, you can also enter the IP parameters in your working environment prior to performing the ultimate installation.

Entering the IP Parameters Using the CLI

Enter the IP parameters using the CLI as follows:

Step	Action	Comment
1	Establish a connection to the switch, following the instructions made in the step action table *(p. 13*.	
2	Change to the privileged EXEC mode by entering `enable`, and press ENTER.	
3	Enter the password, and press ENTER.	Press ENTER without typing the password, since the default setting is no password.
4	Disable DHCP by typing network protocol none, and press the ENTER key.	

Step	Action	Comment
5	Enter the following IP parameters: IP address, network mask and, if applicable, gateway	● IP address The default setting local IP address of the switch is 0.0.0.0. ● network mask Enter the networks mask here if your network has been divided into subnetworks, and if these are identified with a network mask. The default setting of the network mask is 0.0.0.0. ● gateway This entry is only needed if the switch and the management station/tftp server are located in different subnetworks. Type the IP address of the gateway between the subnetwork of the switch and the path to the management station. The default setting of the IP address is 0.0.0.0.
6	Save the configuration entered by typing the command: copy system:running-config nvram:startup-config and press ENTER.	
7	Confirm that you wish to save by pressing Y.	

Configuring the Switch Using the Web-Based Interface

After entering the IP parameters using the CLI, you can easily configure the ESM using the Web-based interface (*p. 39*).

Configuring the ESM Using the Ethernet Switch Configurator (ESC) Software

General Information

Select the IP address using the ESC software if

- the ESM is already installed on your network, or
- if there is another Ethernet connection between your PC and the ESM available.

Note: You can easily configure additional parameters using the Web-based interface (*p. 39*).

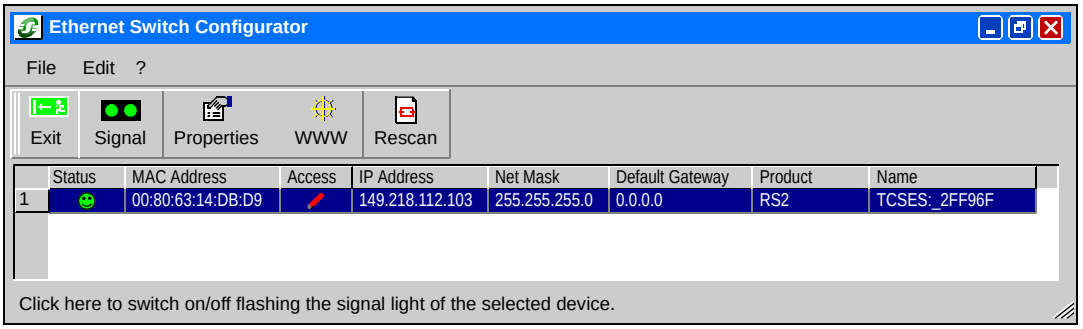
Note: The installation of the ESC involves installing the version 3.0 of the WinPcap software package.
If an earlier version of WinPcap is already installed on the PC, you must uninstall it first. A newer version remains intact when you install the Ethernet Switch configurator. However, this cannot be guaranteed for all future versions of WinPcap. If the installation of the ESC has overwritten a newer version of WinPcap, you must uninstall WinPcap 3.0 and then reinstall the new version.

Installing the ESC Software

Install the WinPcap software on your PC as follows:

Step	Action
1	To install the ESC software on your PC, start the installation program on the CD supplied with the switch, and follow the instructions given by the program.
2	Start the ESC program. Subsequently, the screen displayed below appears.

This figure shows the start screen of the ESC.



General Information concerning the ESC Software

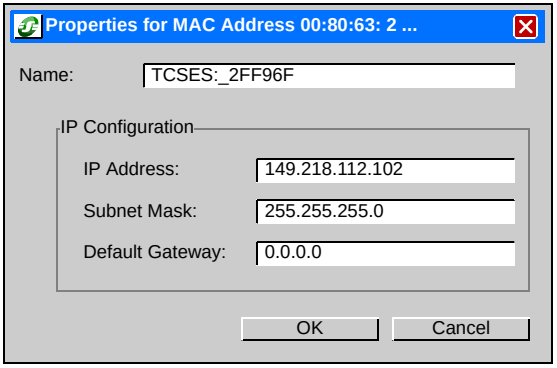
When the ESC software is started, it automatically searches the network for devices supporting the ESC protocol.

The ESC program uses the first PC network card found. If your computer has more than one network card, you can select them on the toolbar of the ESC program.

The ESC program displays a line for each device which responds to the ESC protocol.

Configuring your ESM Using the ESC

Configure the ESM as follows:

Step	Action
1	Select the device line of the ESM.
2	Click the symbol with the two green dots in the toolbar to set the LEDs for the selected device flashing. To switch off the flashing, click the symbol again.
3	Double-click the device line of your switch to open the window displayed below: In this dialog you can enter your device name as well as the IP parameters. 

Step	Action
4	Enter your device name as well as your IP parameters.
5	For security reasons, switch off the ESC function for the device in the Web-based interface after you have assigned the IP parameters to the device (*p. 73*).
6	Save the settings you have made so they will still be available after restart (*p. 50*).

Note: After the IP address has been entered and saved, the ESM loads the local configuration settings (*p. 43*).

Loading the System Configuration from the Memory Back Up Adapter (EAM)

Uses of the EAM

The EAM is a USB device used for

- storing the configuration data of an ESM,
- storing the ESM software,
- providing back-up for an inoperable ESM.

Loading the System Configuration from the EAM

In case the switch becomes inoperative, the EAM enables a very simple configuration data transfer by means of a substitute switch of the same type.

When you start the switch, it checks for an EAM. If it detects an EAM with a valid password and valid software, the ESM loads the configuration data from the EAM.

The password is valid if

- the password on the ESM matches the password on the EAM, or
- the default password is saved on the ESM.

To save the configuration data in the EAM (*p. 50*).

Note: If you replace an ESM, ensure that the DIP switch settings on the replacement switch are identical to the original one.

EAM Status

The status of the EAM is indicted in the EAM Status area of the Load/Save dialog box (*p. 44*) as listed below:

Status	Meaning
NotPresent	No EAM connected.
ok	The configuration data on the EAM and the ESM are identical.
removed	The EAM was removed after booting.
NotinSync	The configuration data on the EAM and the ESM are not consistent.
OutOfMemory	The local configuration data is too extensive to be stored on the EAM.
WrongMachine	The EAM's configuration data came from a different device type and cannot be read by the ESM.
ChecksumErr	The configuration data is damaged.

You can refresh the EAM Status display by clicking on the Reload button.

System Configuration Using BOOTP

Basic Information

To configure the ESM using BOOTP, you need a BOOTP server. The BOOTP server matches the configuration data to the ESM on the basis of its MAC address.

Note: For loading the configuration data, the ESM default setting is DHCP mode, so this method requires changing the ESM to the BOOTP mode.

Configuration Procedure Using CLI or the Web-Based Interface

Configure the ESM as follows:

Step	Action
1	Activate BOOTP to receive the configuration data in the CLI *(p. 39*).
2	Change to the privileged EXEC mode by typing enable, and press the ENTER key.
3	Enable BOOTP by typing: network protocol BOOTP and pressing the ENTER key.
4	Perform the configuration, providing the BOOTP server with the switch data listed under ESM Data for BOOTP Server (below).
5	Save the configuration performed by typing the command: copy system:running nvram:startup-config and pressing the ENTER key.
6	Confirm that you wish to save the configuration by pressing Y.

ESM Data for BOOTP Server

Provide the BOOTP server with the following ESM data:

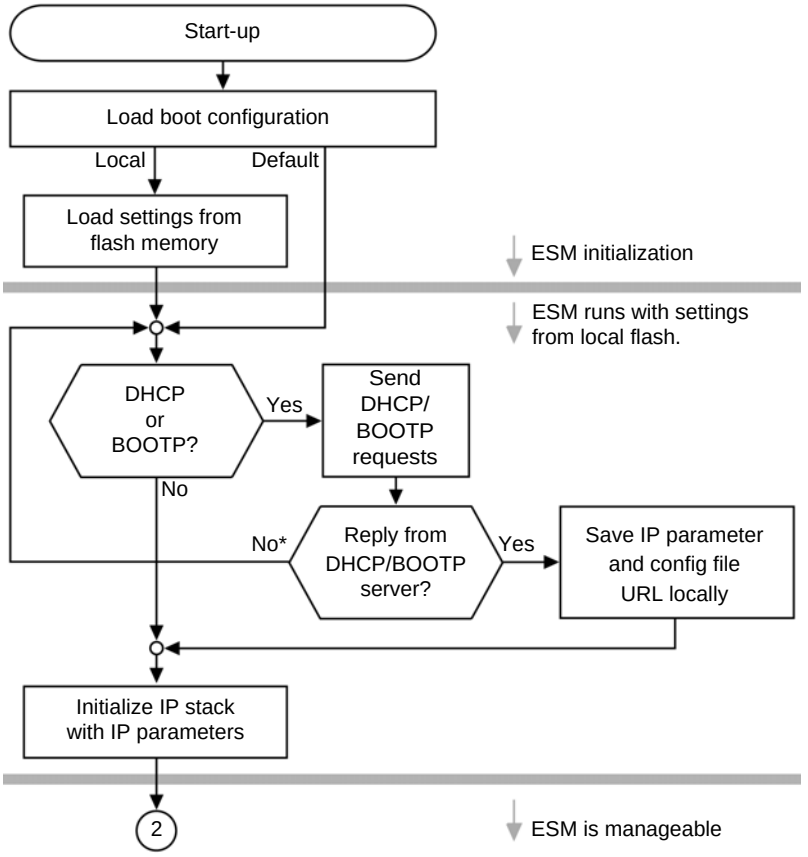
```
# /etc./bootptab for BOOTP-daemon bootpd
#
# gw -- gateways
# ha -- hardware address
# ht -- hardware type
# ip -- IP address
# sm -- subnet mask
# tc -- template

.global:/
:gw=0.0.0.0:/
:sm=255.255.240.0:
rs2:01:ht=ether
net:ha=008063086501:ip=149.218.17.83:tc=.global:
rs2_02:ht=ether-
net:ha=008063086502:ip=149.218.17.84:tc=.global:
```

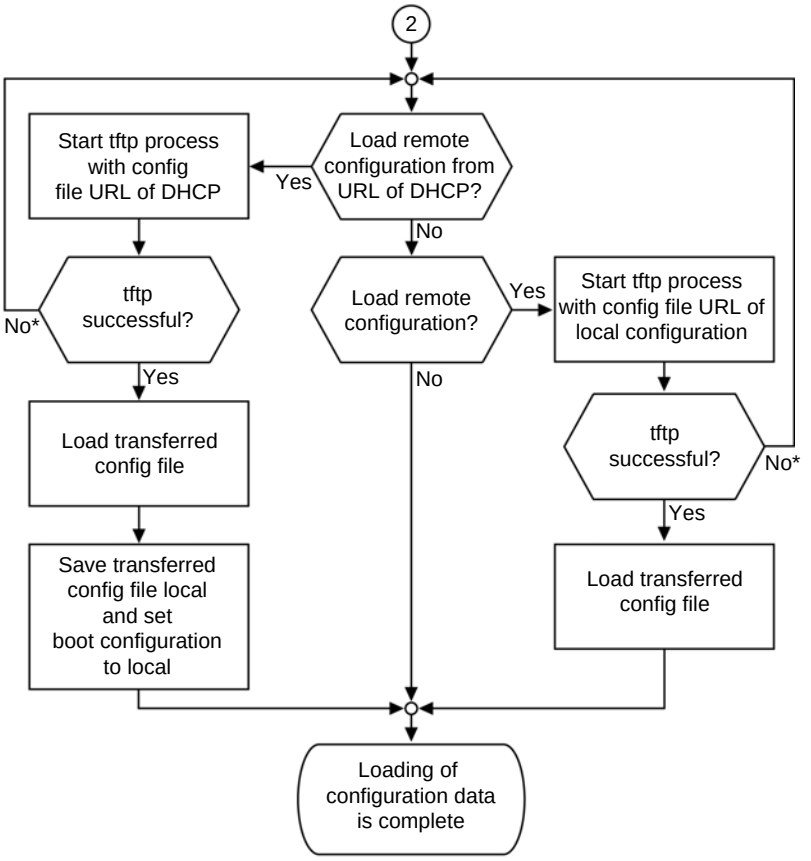
Note: Lines that start with a # character are comment lines. The lines under global make the configuration of several devices easier. The template (tc) allows you to allocate the global configuration data (tc=.global:). The direct allocation of the hardware or IP address occurs in the device lines (rs2-0).

Flow Chart for the BOOTP Process

This figure illustrates the BOOTP process.



The following figure shows part 2 of the BOOTP/DHCP process.



Note: The agent of the ESM does not support IEEE 802.3 frame type.

System Configuration Using DHCP

General Information

To configure the system via DHCP (Dynamic Host Configuration Protocol), you need a DHCP server. The DHCP server matches the configuration data to the ESM on the basis of its MAC address or its system name.

The DHCP (responds similar to the BOOTP and offers in addition the configuration of a DHCP client with a name instead of the MAC address. For the DHCP, this name is known as the client identifier in accordance with rfc 2131.

The ESM uses the name entered under `sysName` as the client identifier in the system group of the MIB II. You can enter the system name directly via SNMP, the Web-based management or the user interface.

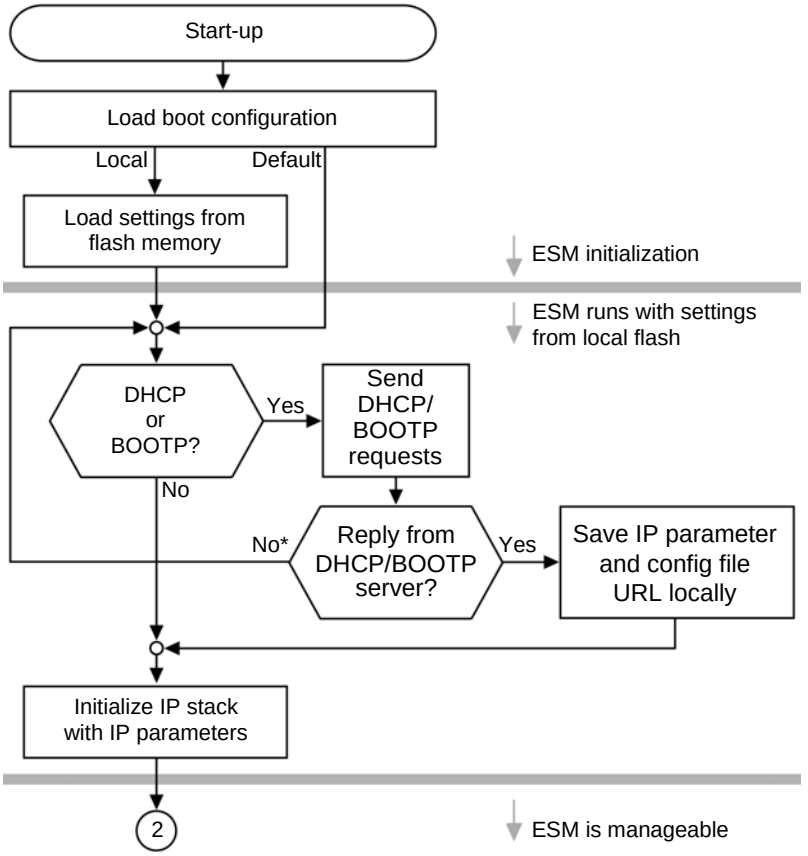
Configuration Procedure Using the CLI or the Web-Based Interface

Configure the ESM as follows:

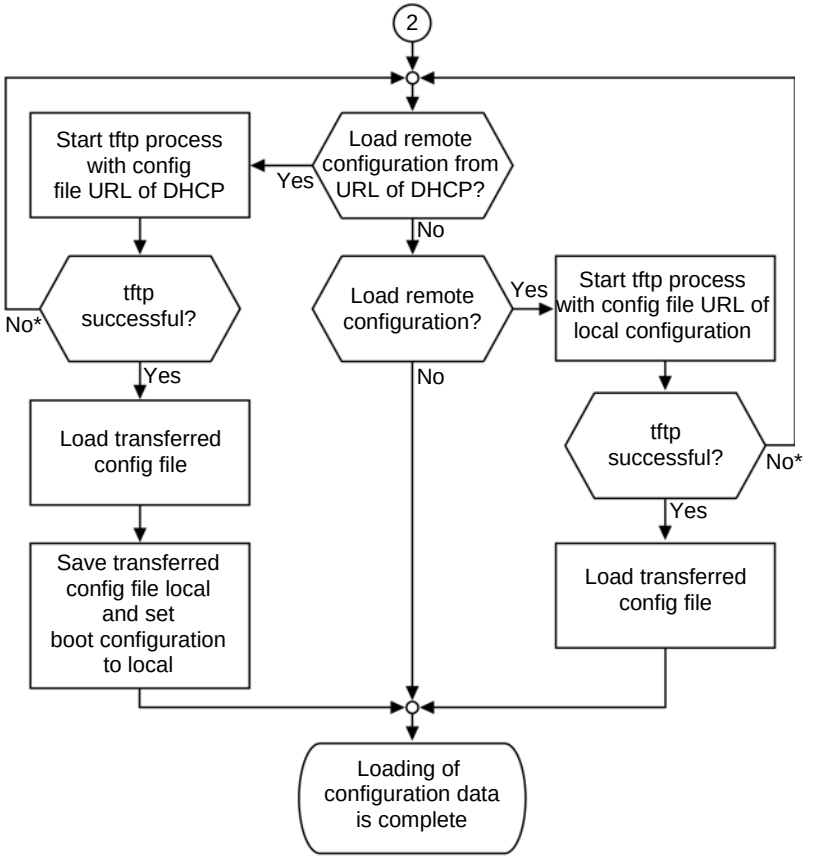
Step	Action
1	Connect the ESM to a serial cable when using the CLI and to an Ethernet cable when using the Web-based interface.
2	Activate DHCP to receive the configuration data in the CLI (*p. 39*).
3	Change to the privileged EXEC mode by typing `enable`, and press the ENTER key.
4	Enable DHCP by typing `configure protocol DHCP`, and press the ENTER key.
5	Perform the configuration, providing the DHCP server with the required switch data.
6	Save the configuration performed by typing the command `copy system:running nvram:startup-config`, and press the ENTER key.
7	Confirm that you wish to save the configuration by pressing Y.

Flow Chart for the DHCP Process

On startup, an ESM receives its configuration data according to the BOOTP/DHCP procedure described in the following chart:



The following shows part 2 of the BOOTP/DHCP process.



The ESM sends its system name to the DHCP server. The DHCP server can then assign an IP address as an alternative to the MAC address by using the system name.

In addition to the IP address, the DHCP server sends

- the tftp server name (if present) and
- the name of the configuration file (if present).

The ESM accepts this data as configuration parameters (*p. 39*). If an IP address has been assigned by a DHCP server, it will be permanently saved in the local memory.

The ESM requests these DHCP options:

Option	Meaning
1	subnet mask
2	time offset
3	router
4	time server
12	host name
66	tftp server name
67	bootfile name

The special feature of DHCP in contrast to BOOTP is that the server can only provide the configuration parameters for a certain period of time (lease). When the time period expires (lease duration), the DHCP client must attempt to renew the lease or negotiate a new one. A BOOTP-similar response can be set on the server (i.e., the same IP address is always assigned to a particular client using the MAC address), but this requires the explicit configuration of a DHCP server in the network. If this configuration was not performed, a random IP address (whichever one happens to be available) is assigned.

Default setting is DHCP enabled.

As long as DHCP is activated, the ESM attempts to obtain an IP address. If it cannot find a DHCP server after restarting, it will not have an IP address.

To activate or deactivate DHCP, refer to *System Configuration Using the Web-Based Interface, p. 39*.

Below you can view an example of a DHCP configuration file:

```
# /etc/dhcpd.conf for DHCP Daemon
#
subnet 149.218.112.0 netmask 255.255.240.0 {
    option subnet-mask 255.255.240.0;
    option routers 149.218.112.96;}
#
# Host berta requests IP configuration
# with her MAC address
#
host berta {
    hardware ethernet 00:80:63:08:65:42;
    fixed-address 149.218.112,82;
    }
#
# Host hugo requests IP configuration
```

```
# with his client identifier.
#
host hugo {
#   option dhcp-client-identifier "hugo";
    option dhcp-client-identifier 00:68:75:67:6f;
    fixed-address 149.218.112.83;
    server-name "149.218.112.11";
    filename "/agent/config.dat";
}
```

Lines that start with a # character are comment lines.The lines preceding the individually listed devices refer to settings that apply to all the following devices.The fixed-address line assigns a permanent IP address to the device.

System Configuration Using DHCP Option 82

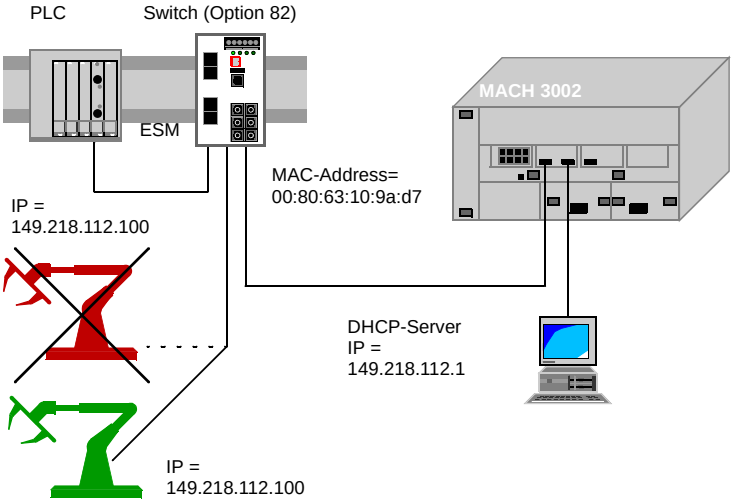
General Information

If you want to configure the system using DHCP Option 82, you need a DHCP server with Option 82. The DHCP server matches the configuration data to the ESM based on its physical connection.

As with the classic DHCP, on startup an agent receives its configuration data according to the BOOTP/DHCP process flow chart (*p. 34*).

The system configuration is based on the classic DHCP protocol on the device being configured, whereas Option 82 is based on the network topology. This procedure allows you to always assign the same IP address to any device connected to a particular location (port of a switch) on the LAN. For the installation and configuration of a DHCP Option 82 server (*p. 281*.)

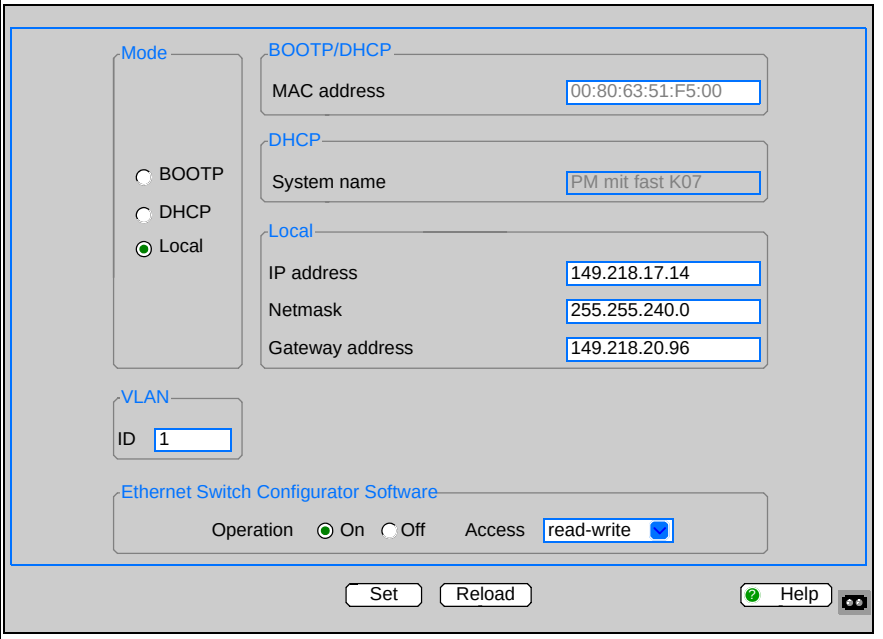
The figure shows an application example of DHCP Option 82.



System Configuration Using the Web-Based Interface

Configuration Procedure Using the Web-Based Interface

Perform the configuration as follows:

Step	Action
1	Connect the ESM to an Ethernet cable.
2	Open the Web-based interface.
3	Go to Basics → Network. The figure below shows the Network dialog box. 
4	Under Mode select where the ESM receives its IP parameters from: ● In the BOOTP mode, the configuration parameters are assigned via a BOOTP or DHCP server on the basis of the MAC address of the ESM. ● In the DHCP mode, the configuration parameters are assigned via a DHCP server on the basis of the MAC address or the name of the ESM. ● In the Local mode, the net parameters in the ESM memory are used.
5	Enter the parameters according to the mode selected.
6	In the System Name line, enter the system name applicable to the DHCP protocol.

Step	Action
7	In the Local frame, assign an Agent IP address, a Netmask and a Gateway Address to the ESM.
8	In the VLAN ID group box, you can assign a VLAN (*p. 294*) to the ESM. **Note:** If you enter a value of 0 here, the agent can be accessed by all VLANs.
9	An alternative method to assign the IP address is to use the Ethernet Switch Configurator software provided with the ESM (*p. 25*).
10	Save the settings you have made to ensure they are still available after restart (*p. 50*).

Faulty Device Replacement

Solutions for Faulty Device Replacement

There are two plug-and-play solutions available for replacing an inoperative ESM:

- First, you can configure the new switch using an Memory back up adapter (EAM) (*p. 43*).
- Second, you can configure the new switch using DHCP Option 82 (*p. 38*).

In both cases, the same configuration data which the inoperative ESM had are transferred to the new ESM during booting.

Loading and Saving Settings

3

Loading Settings

Sources for Loading Settings

During operation, the ESM enables you to load settings from the following sources:

- the local non-volatile memory
- the Memory back up adapter (If a Memory back up adapter (EAM) is connected to the ESM, the ESM always loads its configuration from the EAM.)
- a file on the connected network (the default setting)
- a binary file or an editable script on a PC

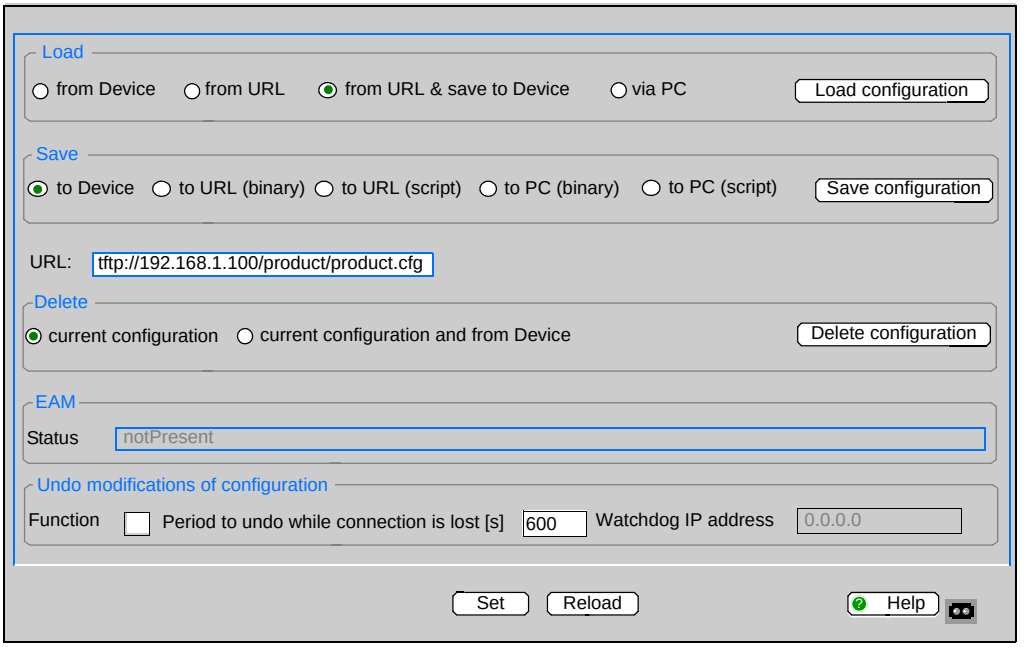
Whenever it is restarted, the ESM automatically loads its configuration data from the local non-volatile memory, provided that you have not activatd BOOTP/DHCP and no EAM is connected to the switch.

Note: When loading a configuration, do not access the switch until it has loaded the configuration file and has made the new configuration settings. Depending on the complexity of the configuration settings, this procedure can last between 10-200 seconds.

Loading Settings from the Local Non-Volatile Memory Using the Web-Based Interface

You can load the ESM locally from its non-volatile memory as long as you have not activated the BOOTP/DHCP server and an EAM is not connected to the switch.

Proceed as follows using the Web-Based Interface:

Step	Action
1	Open the Web-based interface (*p. 14*).
2	Go to Basics → Load/Save. The Load/Save dialog box appears as shown below. 
3	Select from Device in the Load group box.
4	Click Load Configuration.

Loading Settings from the EAM

The EAM can be used in the event of a switch that becomes inoperative or to correct a misconfigured switch. The two conditions for using the EAM are:

- the ESMs settings must have been previously saved (*p. 50*) to the EAM
- the EAM must be connected to the ESM

To load settings to the ESM from the EAM:

Step	Action
1	Remove power from the ESM
2	Connect the EAM to the USB port on the ESM
3	Power on the ESM

Upon power up, the ESMs configuration and IP address settings will be automatically loaded to its memory. The EAM can be removed once the loading is completed.

Note: If an EAM remains connected to the ESM, the ESM will load its configuration from the EAM during each restart of the switch.

Loading Settings from the Local Non-Volatile Memory Using the Command Line Interface (CLI)

Proceed as follows in the CLI:

Step	Action
1	Connect the ESM to a serial cable.
2	Open the CLI.
3	Enter the command `enable` to change to the privileged EXEC mode.
4	Enter the command `copy nvram:startup-config system:running-config` to load the configuration data from the local non-volatile memory.

Note: If an EAM is connected to the ESM, the ESM always loads its configuration from the EAM. For information on how to save a configuration file onto an EAM using the CLI, refer to Saving Locally on the EAM (*p. 50*).

Loading Settings from a File

The ESM enables you to load the configuration data from a file in the connected network, provided that no EAM is connected to it.

Loading Settings from a File Using the Web-Based Interface

Proceed as follows using the Web-Based Interface:

Step	Action
1	Open the Web-based interface (*p. 14*).

Step	Action
2	Go to Basics → Load/Save.The Load/Save dialog box appears (see above).
3	In the Load group box: ● select from URL if you want the ESM to load the configuration data from a file but still retain its locally saved configuration. ● select from URL & Save to Device if you want the ESM to load the configuration data from a file and to save it as the ESM's local configuration. ● Select via PC if you want the ESM to load the configuration data from a PC file and retain its locally saved configuration.
4	If you select from a PC, skip to last step (Load Configuration).
5	In the URL edit box, type the path (see below) under which the ESM will find the configuration file.
6	Click Load Configuration.

Format of the URL

The URL identifies the path to the tftp server from which the device loads the configuration file. The URL is in the format: tftp://[IP address of the tftp server]/[path name]/[file name] for example: *tftp://149.218.112.5/switch/config.dat*

Example of Loading a File from the TFTP Server Using the Web-Based Interface

Load a file from the tftp server as follows:

Step	Action
1	In order to download a file from the tftp server, you have to save the configuration file to the corresponding path of the tftp server with the file name, e.g. *switch/switch_o1.cfg* (*p. 51*) .
2	Type the path to the tftp server in the URL text box, e.g. *tftp://149.218.112.5/ESM/config.dat*. To load from an ETY or NOE module, the URL is: `tftp://IPaddress//RAM0/switch rolename.prm` where the *IPaddress* is the IP address of the module and *switch rolename* is the roll name assigned to the switch.

Trouble Shooting Using the Web-Based Interface

If you get an status message while saving the configuration (step 1, above), refer to the below procedure:

Step	Action	Comment
1	View the status of the loading procedure by selecting from URL & Save to Device of the Load group box.	One reason for the status message may be that the loading procedure has not been completed. DHCP/BOOTP does not finish the loading procedure until a valid configuration has been loaded.
2	If DHCP/BOOTP cannot find a valid configuration, then finish the loading process by loading the ESM's local configuration by selecting from Device of the Load group box.	

Loading Settings from a File Using the CLI

Load settings from a file as follows:

Step	Action
1	Connect the ESM to a serial cable.
2	Open the CLI.
3	Enter the `enable` command to change to the privileged EXEC mode.
4	Enter the command `copy tftp://149.218.112.159/switch/config.dat nv-ram:startup-config` if you want the switch to load the configuration data from a tftp server in the connected network.

Resetting the Configuration to the Default Settings

The ESM enables you to:

- reset its current configuration to the default settings (The locally saved configuration is retained.),
- reset the ESM to the default settings. After a restart, the IP address is also set to the default setting.

Resetting the Configuration to the Default Settings Using the Web-Based Interface

Reset the configuration to the default settings as follows:.

Step	Action
1	Open the Web-based interfacenterface (*p. 14*)
2	Go to Basics → Load/Save.
3	In the Delete group box: ● select current configuration if you want the ESM to have its current configuration reset to the default settings and have its locally saved configuration retained. ● select current configuration and from Device if you want the ESM to have its current configuration reset to the default settings and have its IP address reset to the default setting after the next restart.
4	Click Delete configuration.

Resetting the Configuration to the Default Settings Using the System Monitor

Reset the configuration to the default settings as follows:

Step	Action	Comment
1	Connect the ESM V.24 socket to a terminal or VT 100 emulator PC using a terminal cable.	
2	Open the System Monitor.	
3	Select 5 Erase main configuration file.	This menu allows you to reset the switch to its default settings. The ESM saves configurations which differ from the default settings in the *ESM.cfg* file of the flash memory.
4	Press the ENTER key.	This deletes the existing settings of the *ESM.cfg* file and returns it to the default settings.

Adjusting for Interruptions to the ESM

When an interruption to the ESM connection occurs, the Load/Save dialog box provides a means for you to automatically reload the last configuration that was saved. You accomplish this with the Undo modifications of configuration function.

When this function is activated, and the ESM is interruped for a longer period of time than you specify, the switch will reload the last configuation that was saved prior to the interruption.

Activating the Undo Modifications Funcion

You should activate the Undo modifications of configuration function before you configure the ESM, so that if an interruption occurs during the configuration, you will be reconnected to the switch again. To do this, proceed as follows:

Step	Action
1	Open the Web-based interfacenterface (*p. 14*)
2	Go to Basics → Load/Save.
3	Select **Function**in the **Undo modifications of configuration** group box.
4	Enter a value in the **Period to undo while connection is lost** text box. The range is 10 to 600 seconds and the default value is 600 seconds. **Note:**Deactive the function after you have successfully saved the ESM configuration (*p. 50*). This will prevent the switch from reloading the configuration when you close the web interface.

Watchdog IP Address

The Watchdog IP address appearing on the Load/Save dialog box indicates the IP address of the PC that activated the watchdog function. The ESM monitors the link to the PC, checking for interruptions.

Saving Settings

Options for Saving Settings

The ESM enables you to save the settings you have made

- locally
- locally and on the EAM
- to a file

Saving Locally and on the EAM Using the Web-Based Interface

Save the current configuration data as follows:.

Step	Action
1	Connect the ESM to an Ethernet cable.
2	Open the Web-based interface.
3	Go to Basics → Load/Save.
4	Click to Device in the Save group box.
5	Click Save Configuration. As a result, the ESM saves the current configuration data to the local non-volatile memory and, provided that an EAM is connected, also to the EAM.

Saving Locally and on the EAM Using the CLI

Save the current configuration data as follows:

Step	Action
1	Connect the ESM to a serial cable.
2	Open the CLI.
3	Enter the command enable to change to the Privileged EXEC mode.
4	Enter the command: copy system:running-config nvram:startup-config to save the current configuration data to both the local non-volatile memory and to the EAM if an EAM is connected.

Saving to a File Using the Web-Based Interface

Save the configuration data to a file as follows:.

Step	Action	Comment
1	Connect the ESM to an Ethernet cable.	
2	Open the Web-based interface.	
3	Go to Basics → Load/Save.	
4	Click to URL in the Save group box.	
5	Type in the URL edit field the path under which you want the ESM to save the configuration file.	
6	Click Save Configuration.	The URL marks the path to the tftp server on which the switch saves the configuration file. The URL is written as follows: tftp://IP address of the tftp server/path name/ file name e.g. tftp://149.218.112.5/switch/config.dat. To save from an ETY or NOE module, the URL is: tftp://IPaddress//RAM0/switch rolename.prm where the IPaddress is the IP address of the module and switch rolename is the roll name assigned to the switch.

Note: The configuration file contains all configuration data, including the password. Thus, note the access rights on the tftp server.

Saving to a File Using the CLI

This table outlines the procedure to save the current configuration data to a file using the command line interface.

Step	Action
1	Connect the ESM to a serial cable.
2	Open the CLI.
3	Enter the command enable to change to the privileged EXEC mode.
4	Enter the command: copy nvram:startup-config tftp://149.218.112.159/switch/config.dat if you want the switch to load the current configuration data from a tftp server in the connected network.

Loading Software Updates

4

Loading Software from the EAM Memory Back-up Adapter

Checking the Software Release Installed Using the Web-Based Interface

Check the software release installed on your ESM as follows:

Step	Action
1	Open the Web-based interface.
2	Connect the ESM with an Ethernet cable.
3	Go to Basics | Software to view the release number of the software installed on your ESM.

Loading Procedure Using the CLI

Load the software from the EAM as follows:

Step	Action	Comment
1	Connect the EAM to which you have copied the ESM software to the USB port of the ESM.	
2	Connect the ESM to a terminal or a VT 100 emulator using a terminal cable.	
3	Start the terminal program on the PC and establish a connection with the ESM.	
4	Reboot the ESM.	While the ESM is booting, the following message appears on the terminal: Press <1> to enter System Monitor 1...
5	Type `1` within 1 s to start System Monitor 1.	System Monitor 1 displays the following: **1.** Select Boot Operating System **2.** Update Operating System **3.** Start Selected Operating System **4.** End (reset and reboot) **5.** Erase main configuration file **6.** Show Bootcode Information

Step	Action	Comment
6	Select **2**, and press the ENTER key to copy the software from the EAM into the local memory of the ESM.	On concluding the update, the System Monitor prompts you to press any key to continue.
7	Select **3** to start the new software on the ESM.	

Loading the Software from the EAM Using a Computer

Like a standard USB memory stick, you can also connect the EAM to an USB port of your PC and copy the ESM software to the main directory of the EAM (*p. 50*).

Further System Monitor Options

In addition, the System Monitor features further options in connection with your ESM software:

- swapping the software images available
- performing a cold start

Swapping the Software Images

Swap the software images as follows:

Step	Action	Comment
1	On the start screen of the System Monitor, select: 1 Boot Operating System	A new screen appears.

Step	Action	Comment
2	On the new screen, select **1** to swap the two software images available (In connection with the swapping of the images see also **1 - 7**).	1 Swap Os images The memory of the ESM offers space for two images of the software. Via this item you can load a new version of the software without erasing the existing version. 2 Copy image to backup Via this item you can save a copy of the active software. 3 Test stored images in Flash mem. Via this item you can test whether the stored images in the flash memory contain valid codes. 4 Test stored images in USB mem. Via this item you can test whether the stored images of the software on the EAM contain valid codes. 5 Apply and store selection Via this item you can apply and store the selection of the software. 6 Reformat Flash file system Via this item you can reformat the flash file system. 7 Cancel selection Via this item you can cancel the selection and leave this dialog without changes.

Performing a Cold Start

Perform a cold start as follows:

Step	Action
1	On the start screen of the System Monitor, select 4 End (reset and reboot) to perform a cold start.

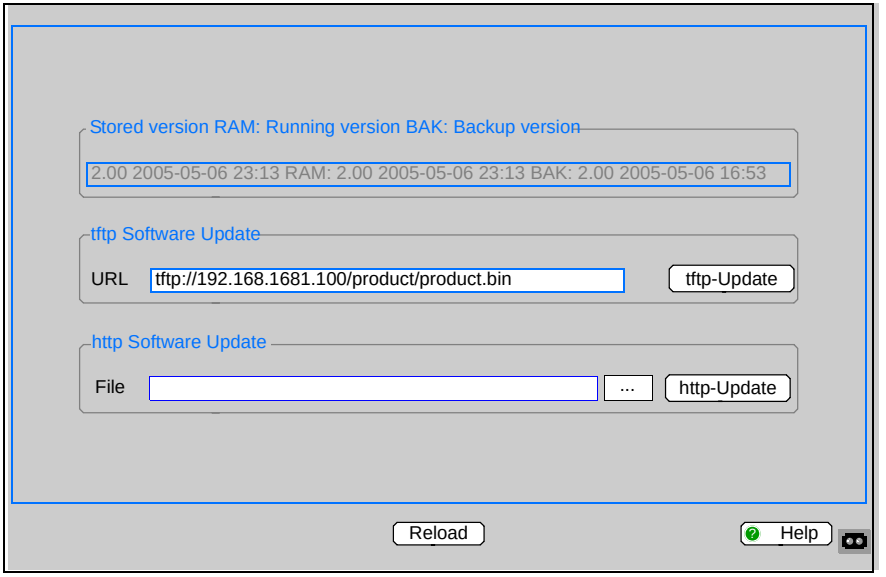
Loading Software Updates from the TFTP Server

TFTP Server

Note: For a tftp tftp update you need a tftp server on which the ESM software you wish to load is saved.

Loading Procedure Using the Web-Based Interface

Download ESM software updates from the tftp server as follows:

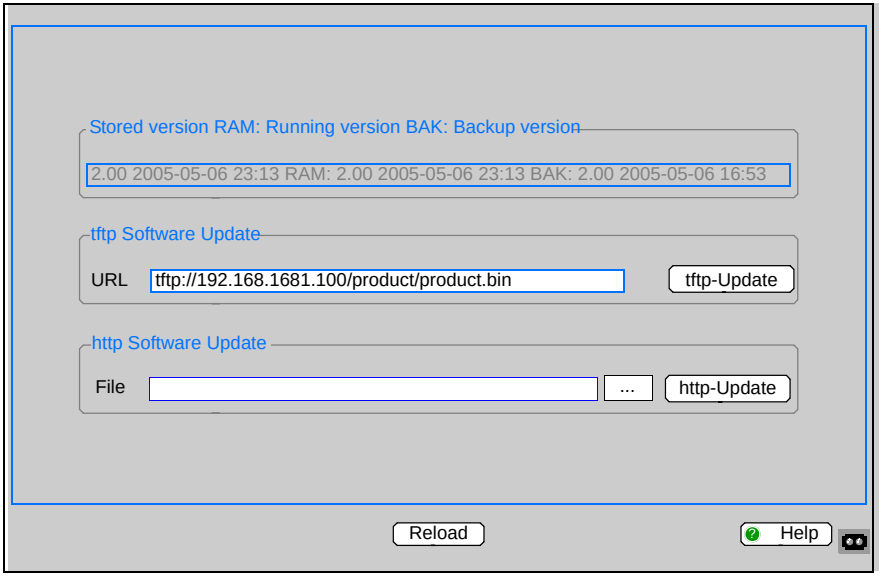
Step	Action
1	Connect the ESM to an Ethernet cable.
2	Open the Web-based interface.
3	Go to Basics | Software. The screen below shows the Software dialog box.  In the tftp Software Update block, the URL text box identifies the path to the software stored on the tftp server. It is written as follows: tftp://IP address of the tftp server/path name/file name (e.g. tftp://149.218.112.4/esm/esm.bin
4	In the URL text box, enter the correct path to the tftp server.

Step	Action
5	Click tftp Update to load the software from the tftp server onto the ESM. One of the following messages is displayed when the update has been completed: ● Update completed successfully. ● Update failed. Reason: incorrect file. ● Update failed. Reason: an inoperable condition exists when saving.
6	After the loading procedure has been completed successfully, activate the new software as follows: Go to Basics | Restart, and perform a cold start. The ESM reloads the software from its non-volatile memory, restarts, and performs a selftest.
7	Close the browser window: File | Close to return to the Software dialog box.
8	Click Reload on the Software dialog box to re-enable your access to the ESM.

Loading Software Updates via HTTP

Loading Procedure

Proceed as follows to update the software on your switch:

Step	Action
1	Connect the ESM to an Ethernet cable.
2	Open the Web-based interface.
3	Go to Basics | Software. The following dialog box appears: 
4	Click the **...** button in the http Software Update block. This allows you to browse to the location on your PC where the ESM software is located.
5	Select the ESM software file.
6	Click on http Update to transfer the software from the http server onto the ESM. One of the following messages is displayed when the update has been completed: ● Update completed successfully. ● Update failed. Reason: incorrect file. ● Update failed. Reason: inoperable condition exists when saving.
7	After the loading procedure has been completed successfully, activate the new software as follows: Go to Basics | Restart, and perform a cold start. The ESM reloads the software from its non-volatile memory, restarts, and performs a selftest.

Step	Action
8	Close the browser window: File | Close to return to the Software dialog box.
9	Click Reload on the Software dialog box to re-enable your access to the ESM.

Port Configuration

5

Port Configuration Dialog Box

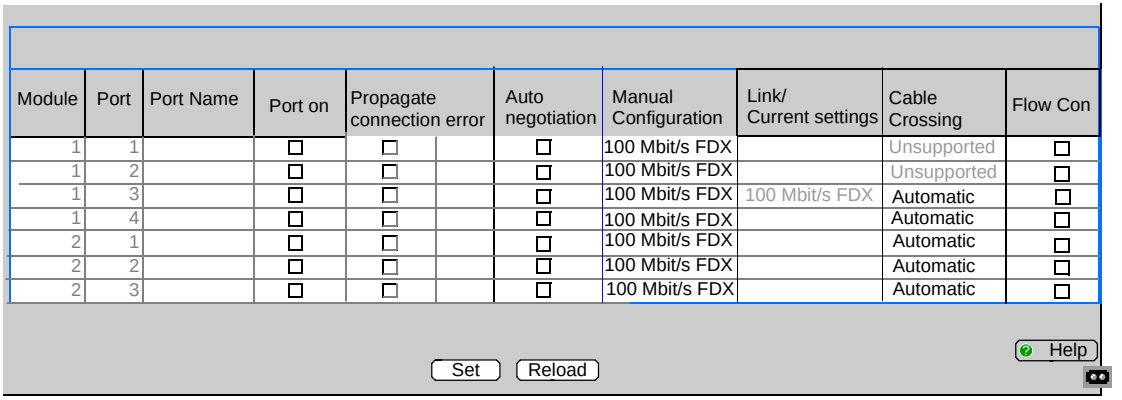
Purpose

The tabular format of the Port Configuration dialog box allows you to configure every port on the ESM switch.

Accessing the Port Configuration Dialog Box

You can access the Port Configuration dialog box from the ESM's web-based browser:

Step	Action
1	Connect the ESM to an Ethernet cable.
2	Open the Web-based interface.
3	Go to Basics → Port Configuration. The Port Configuration dialog box appears on the screen as shown below.



Module	Port	Port Name	Port on	Propagate connection error	Auto negotiation	Manual Configuration	Link/ Current settings	Cable Crossing	Flow Con
1	1		☐	☐	☐	100 Mbit/s FDX		Unsupported	☐
1	2		☐	☐	☐	100 Mbit/s FDX		Unsupported	☐
1	3		☐	☐	☐	100 Mbit/s FDX	100 Mbit/s FDX	Automatic	☐
1	4		☐	☐	☐	100 Mbit/s FDX		Automatic	☐
2	1		☐	☐	☐	100 Mbit/s FDX		Automatic	☐
2	2		☐	☐	☐	100 Mbit/s FDX		Automatic	☐
2	3		☐	☐	☐	100 Mbit/s FDX		Automatic	☐

Help

Set Reload

The various features of the Port Configurator dialog box are described below

Naming the Ports

You can enter an arbitrary name for every port in the Port Name column.

Activating the Ports

You can activate each of the ports by clicking the check box in the Port on column.

Identifying Link Alarms

You can specify that a port's signal contact is to be opened when a link alarm occurs by clicking the check box in the Propagate connection error column.

Setting the Port's Operating Mode

You can set the operating mode for each port in the Manual Configuration column. There are four selections that appear in a drop-down box when you click on the port's entry point in that column. The selectable operating modes are:

- 10 Mbit/s half-duplex (HDX)
- 10 Mbit/s full-duplex (FDX)
- 100 Mbit/s half-duplex (HDX)
- 100 Mbit/s full-duplex (FDX)

Note: The choice of operating mode is determined by the media module.

Automatic Selection of the Port's Operating Mode

You can make the selection of a port's operating mode occur automatically by clicking the check box in the Autonegotiation column. Once it's activated, it takes a few seconds for the operating mode to be set.

Note: The active automatic configuration has priority over the manual configuration.

Display of the Current Operating Mode

The Link/Current settings column displays a port's current operating mode and by virtue of that fact identifies that the port has an existing connection.

TP Port Connections

In the Cable Crossing column, you can sign the connections for a twisted pair (TP) port configuration providing that automatic configuration is not activated for the port.

There are three selections that appear in a drop-down box when you click on the port's entry point in that column. The selections are:

- enable-the ESM swaps the transmitting and receiving wire pair of the TP cable connected to the port (MDIX).
- disable-the ESM does not swap the transmitting and receiving wire pair of the TP cable connected to the port (MDI).
- unsupported-the ESM does not support this function it is either an optical port or a TP SFP port.

Activating Flow Control for a Port

You can activate flow control (*p. 129*) at a port by clicking the check box in the Flow Control column. This action must occur in conjunction with the ESM's Switching Global feature.

Note: You can activate flow control at all the ESM ports with the Switching Global dialog box (*p. 130*).

Switching the Ports on and off

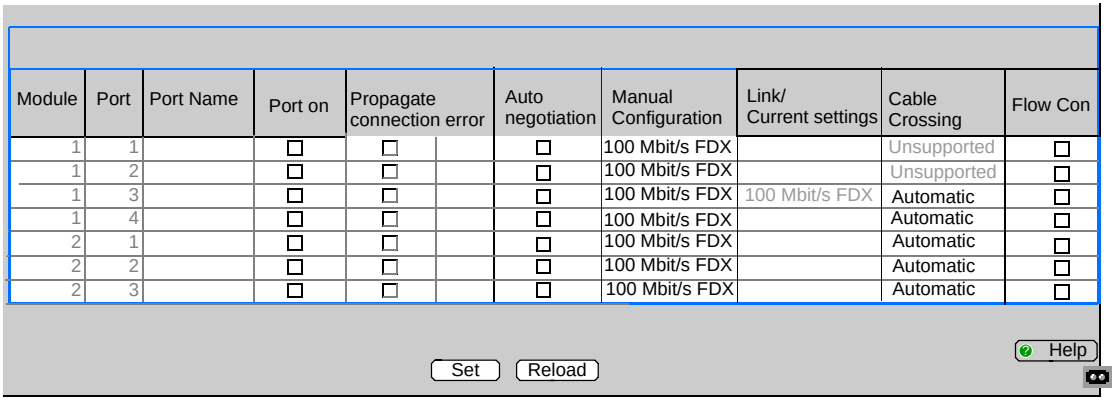
Enhancing Access Security

In the the default setting for the ESM, all ports are switched on. To enhance access security, you should switch off the ports which are not in use.

Procedure Using the Web-Based Interface

Switch the ports on and off as follows:

Step	Action
1	Connect the ESM to an Ethernet cable.
2	Open the Web-based interface.
3	Go to Basics → Port Configuration.
4	To switch on ports,in the Port On column, select the ports which a device will be connected to.
5	To switch off ports,in the Port On column, de-select the ports which a device will not be connected to.



Module	Port	Port Name	Port on	Propagate connection error	Auto negotiation	Manual Configuration	Link/ Current settings	Cable Crossing	Flow Con
1	1		☐	☐	☐	100 Mbit/s FDX		Unsupported	☐
1	2		☐	☐	☐	100 Mbit/s FDX		Unsupported	☐
1	3		☐	☐	☐	100 Mbit/s FDX	100 Mbit/s FDX	Automatic	☐
1	4		☐	☐	☐	100 Mbit/s FDX		Automatic	☐
2	1		☐	☐	☐	100 Mbit/s FDX		Automatic	☐
2	2		☐	☐	☐	100 Mbit/s FDX		Automatic	☐
2	3		☐	☐	☐	100 Mbit/s FDX		Automatic	☐

Set Reload Help

Selecting the Operation Mode

Default Settings

The default setting for all ports is Auto-negotiation mode.

Procedure Using the Web-Based Interface

Change to Auto-negotiation mode as follows:

Step	Action
1	Connect the ESM to an Ethernet cable.
2	Open the Web-based interface.
3	Go to Basics → Port Configuration.
4	If the device connected to this port requires a fixed setting ● select the operation mode (transfer speed, duplex operation) in the Manual Configuration column, ● and deactivate the port in the Auto-negotiation column.

Note: The active auto-negotiation has priority over the manual configuration.

Propagate Connection Error Messages

General Information

If the ESM is set to default, it will display a connection status message via the signal contact and the LED display. The ESM allows you to disable the displaying of connection status messages, in order to prevent a device that has been turned off from being interpreted as an interrupted line.

Activating Connection Error Messages

Activate the connection error messages as follows:

Step	Action
1	Connect the ESM to an Ethernet cable.
2	Open the Web-based interface.
3	Go to Basics → Port Configuration.
4	In the Propagate connection error column, select the ports whose connections you want to mask the displaying of the connection status message.

Protection from Unauthorized Access

6

The Password for SNMP Access

Description of the Password for SNMP

A network management station communicates with the switch via the Simple Network Management Protocol (SNMP).

Every SNMP packet contains the IP address of the sending computer and the password under which the sender of the packet would like to access the switch MIB.

The switch receives the SNMP packet and compares the IP address of the sending computer and the password with the entries in the MIB of the switch. If the password has the appropriate access right, and if the IP address of the sending computer has been entered, then the switch will allow access.

The default setting is that the switch can be accessed using the **public** (read only) and the **private** (read and write) passwords and their respective login names (**user** or **path**) from every computer.

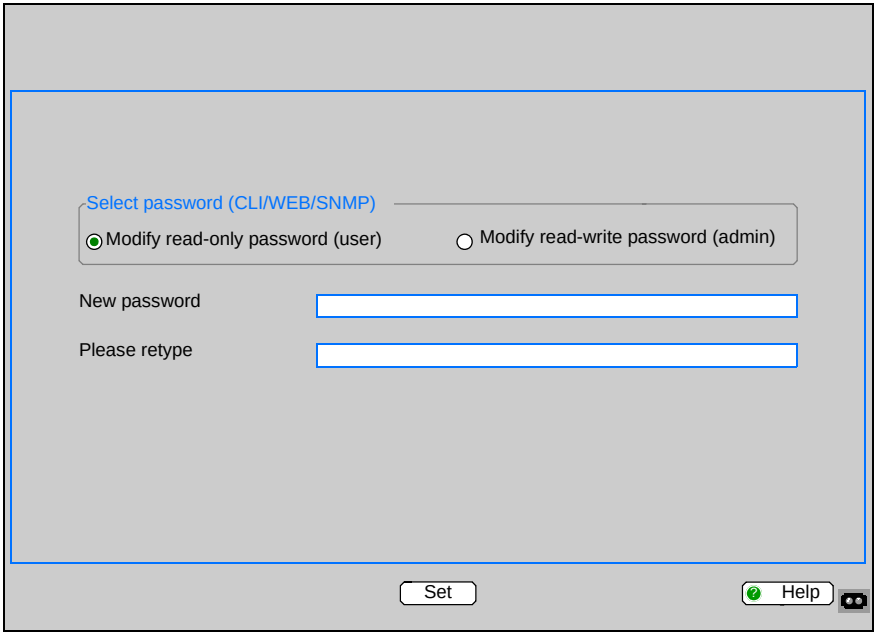
Protecting your Switch from Unwanted Access

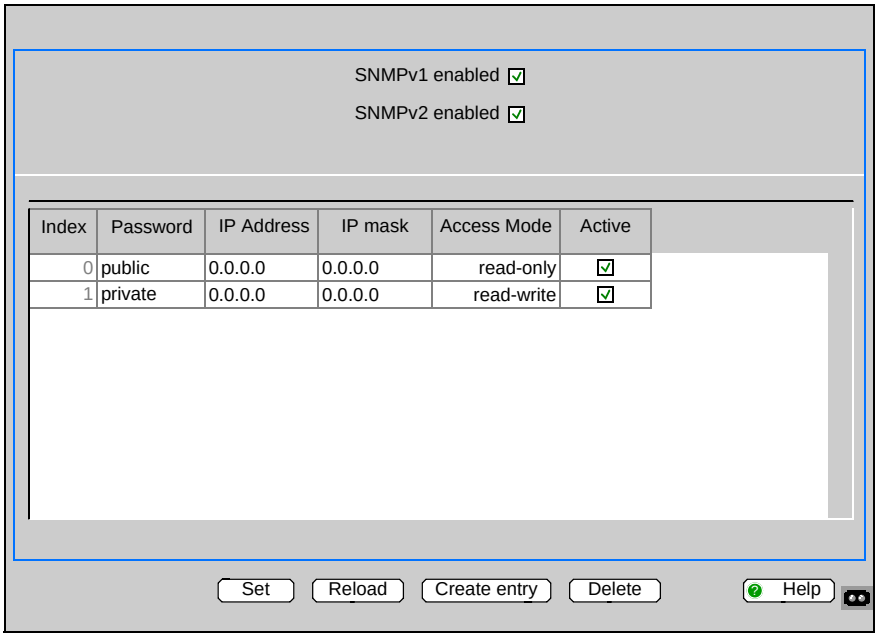
Protect your switch from unauthorized access as follows:

Step	Action
1	Define a new password which you can access from your computer with all rights.
2	Treat this password with discretion, as everyone who knows the password can access the switch MIB with the IP address of your computer.
3	Limit the access rights of the known passwords, or delete their entries.

Entering the Password for SNMP Access Using the Web-Based Interface

Proceed as follows to enter the password for SNMP access:

Step	Action
1	Connect the ESM to an Ethernet cable.
2	Open the Web-based interface.
3	Go to Security → Password/SNMP. The dialog enables you to change the read and read/write passwords for access to the ESM via the Web-based interface/CLI/SNMP. Please note that passwords are case-sensitive. For security reasons, the read password and the read/write password must not be identical. The Web-based interface and the user interface communicate using SNMP version 3. The following figure is displayed on the screen: 
4	Select Modify read-only password (user) to enter the read-only password.
5	Enter the new read-only password in the line New password, and repeat the entry in the line Please retype.
6	Select Modify read-write password (admin) to enter the read-write password.

Step	Action
7	Enter the new read-write password in the line New password, and repeat the entry in the line Please retype. **Note:** If you do not know a password with read/write access, you will not have access to the ESM. **Note:** After changing the password for write access, restart the Web-based interface to access the ESM. **Note:** For security reasons, the passwords are not displayed. Note down each change. You cannot access the ESM without a valid password! **Note:** For security reasons, SNMP version 3 encrypts the password. Enabling SNMPv1 or SNMPv2 unencrypts the password. **Note:** As many applications do not accept passwords shorter than 8 characters, you should use 8 characters for the password.
8	To unencrypt the password, go to Security → SNMPv1/v2 Access, and select SNMPv1 enabled or SNMPv2 enabled.
9	Go to Security → SNMPv1/v2. The following dialog box appears.  TheSNMPv1/v2 dialog box allows you to select the access using SNMPv1 or SNMPv2. The default setting for SNMPv1/v2 is both protocols are enabled, which allows you to communicate with earlier versions of SNMP. Please note that passwords are case-sensitive.
10	To be able to communicate with earlier versions of SNMP, select SNMPv1/2 enabled.

Step	Action
11	Select SNMPv1 enabled or SNMPv2 enabled in the table to determine which IP addresses are allowed to access the ESM and which type of passwords are to be used. The table allows you to create up to 8 entries. For security reasons, the read password and the read/write password must not be identical. Please note that passwords are case-sensitive.
12	To create a new line in the table Click Create entry.
13	To delete an entry, select the line in the table and click Delete. The items in the table have the following meanings: ● Index: current number for this table entry ● password: the computer must use to have access to the ESM; This password is independent of the SNMPv3 password. ● IP address: IP address of the computer permitted to access the ESM ● IP mask: IP mask to the IP address ● Access Mode: determines if the computer has read-only or write access ● Active: enabling/disabling this entry

Setting the Telnet/Web-Based Access

Description of Telnet Access

The Telnet server of the ESM allows you to configure the ESM using the Command Line Interface (CLI). You can switch off the Telnet server to prevent Telnet access to the ESM.

The default setting is that the server is switched on.

After the Telnet server has been switched off, the ESM can no longer be accessed using a Telnet connection.

Note: The Telnet server may be reactivated using the CLI or the Web-based interface via Security → Telnet/Web Access.

Description of Web-Based Access

The Web server of the ESM allows you to configure the ESM using the Web-based interface. You can switch off the Web server to prevent Web access to the ESM.

The default setting is that the server is switched on.

After the Web server has been switched off, the ESM can no longer be accessed using a Web browser.

Note: The Web server may be reactivated using the CLI.

Disabling and Enabling Telnet or Web-Based Access Using the Web-Based Interface

You can disable and enable Telnet or Web access as follows:

Step	Action
1	Connect the ESM to an Ethernet cable.
2	Open the Web-Based interface.
3	Go to Security → Telnet/Web Access.
4	Switch off/on the server to which you wish to disable/enable access.

Enabling and Disabling Telnet Access Using the Command Line Interface (CLI)

You can enable and disable Telnet access as follows:

Step	Action
1	Connect the ESM to a serial cable.
2	Open the CLI.
3	Enter the enable command to change to the privileged EXEC mode.
4	Enter the transport input telnet command to switch on the Telnet server.
5	Enter the no transport input telnet command to switch off the Telnet server.

Enabling and Disabling Web-Based Access Using the CLI

You can enable and disable the Web access via the CLI as follows:

Step	Action
1	Enter the enable command to switch to the privileged EXEC mode.
2	Enter the ip http server command to switch on the Web server.
3	Enter the no ip http server command to switch off the Web server.

Disabling the Ethernet Switch Configurator (ESC) Function

Description of the ESC Software

The ESC software (*p. 25*) allows you to assign an IP address to the ESM on the basis of its MAC address.

Note: For security reasons, either limit or switch off completely the ESC function of the ESM after assigning the IP parameters.

Disabling and Limiting the ESC Function Using the Web-Based Interface

You can disable or limit the ESC function as follows:

Step	Action
1	Connect the ESM to an Ethernet cable.
2	Open the Web-based interface.
3	Go toBasics → Network.
4	Switch off the ESC function in the Ethernet Switch Configurator Software group box, or limit access to Read Only.

Disabling, Limiting and Enabling the Ethernet Switch Configurator Function Using the Command Line Interface

You can disable, limit or enable the Ethernet Switch Configurator function as follows:

Step	Action
1	Connect the ESM to a serial cable.
2	Open the CLI.
3	Type the command `enable` to switch to the privileged EXEC mode.
4	Type the command `network protocol Ethernet Switch Configurator off` to switch off the Ethernet Switch Configurator function.
5	Type the command `network protocol Ethernet Switch Configurator read-only` to switch on the ESC function with the Read access right.
6	Type the command `network protocol Ethernet Switch Configurator read-write` to switch on the ESC function with the Read and Write access right.

Port Security

Description of Port Access Control

The ESM protects every port from unauthorized access.

Depending on your choice, the ESM checks either the MAC address or the IP address of the connected device.

The IP-Based Port Security allows for limiting access to a maximum of 10 addresses.

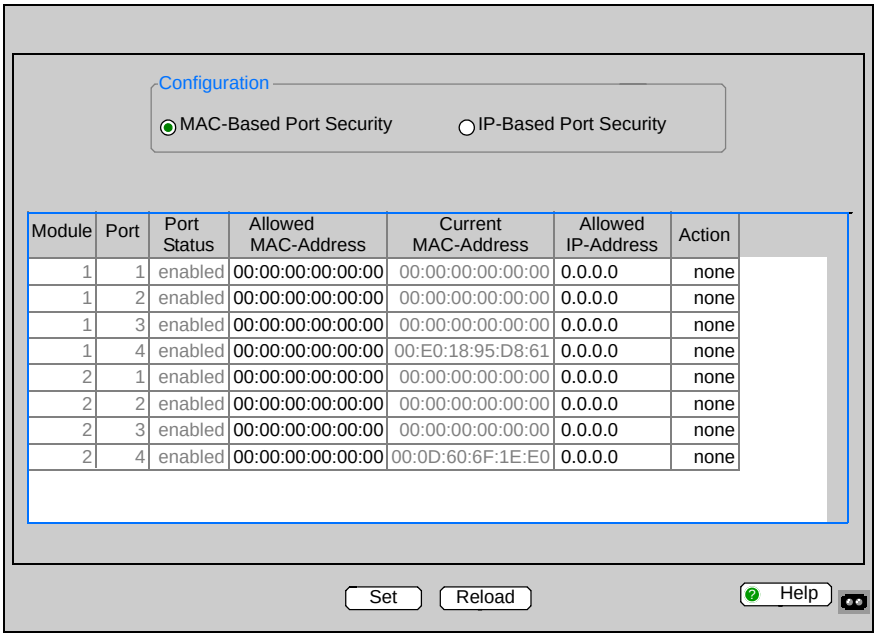
The following functions are available for monitoring every individual port:

- Who has access to this port?
  The ESM recognizes two classes of access control:
  - all: There is no access restriction.
  - user: Only an assigned user has access.
    You define this user with his MAC or IP address.
- What should happen after an unauthorized access attempt?
  The ESM can respond in three selectable ways to an unauthorized access attempt:
  - none: no response
  - trapOnly: message by sending a trap
  - portDisabled: message by sending a trap and disabling a port

Note: Since the ESM is a layer 2 device, it translates the stored IP addresses into MAC addresses. In so doing, a MAC address should be assigned to exactly one IP address. Please bear in mind that when you use a router, several IP addresses can be assigned to one MAC address, namely that of the router. This means that all packets of the router will pass the port unchecked if the permitted IP address is that of the router. If a connected device sends packets with other MAC addresses and a permitted IP address, the ESM will disable the port.

Defining IP-Based Port Access Control Using the Web-Based Interface

Define IP-based port access control as follows:

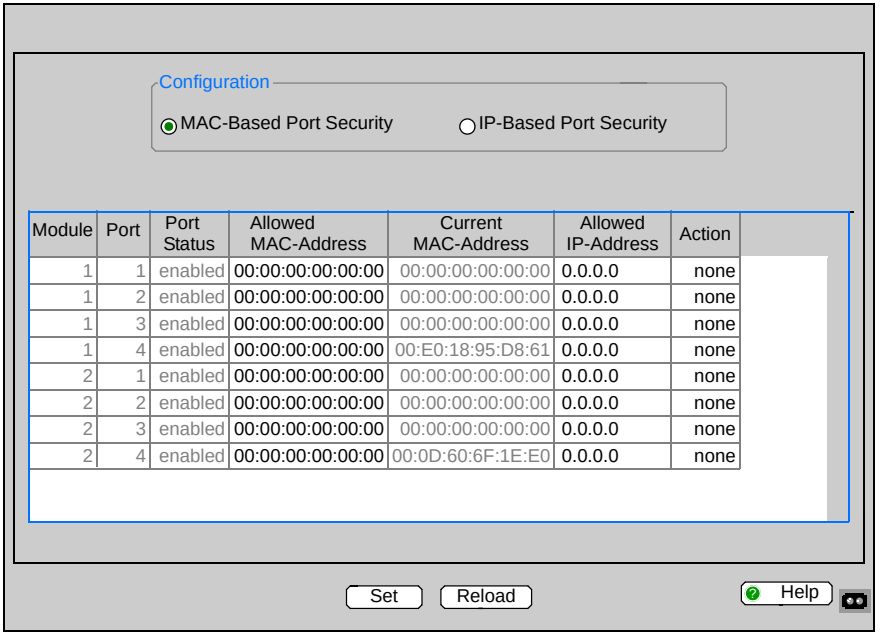
Step	Action
1	Connect the ESM to an Ethernet cable.
2	Open the Web-based interface.
3	Go to Security → Port Security. The following dialog box appears. 
4	Choose IP-Based Port Security.
5	Enter in the Allowed IP address column the IP address of the device with which data exchange is permitted at this port. (Up to 10 addresses (each separated by a space) can be entered). Without an entry, data can be received from any device.

Module	Port	Port Status	Allowed MAC-Address	Current MAC-Address	Allowed IP-Address	Action
1	1	enabled	00:00:00:00:00:00	00:00:00:00:00:00	0.0.0.0	none
1	2	enabled	00:00:00:00:00:00	00:00:00:00:00:00	0.0.0.0	none
1	3	enabled	00:00:00:00:00:00	00:00:00:00:00:00	0.0.0.0	none
1	4	enabled	00:00:00:00:00:00	00:E0:18:95:D8:61	0.0.0.0	none
2	1	enabled	00:00:00:00:00:00	00:00:00:00:00:00	0.0.0.0	none
2	2	enabled	00:00:00:00:00:00	00:00:00:00:00:00	0.0.0.0	none
2	3	enabled	00:00:00:00:00:00	00:00:00:00:00:00	0.0.0.0	none
2	4	enabled	00:00:00:00:00:00	00:0D:60:6F:1E:E0	0.0.0.0	none

Step	Action
6	In the Action column, select one of the following reactions to an unauthorized access attempt: ● no action none) ● message by sending a trap trapOnly) ● the respective port in the Port Configuration table is disabled (*p. 61*) and trap portDisabled(is sent. An entry in the Port Configuration table is part of the configuration and is saved with the configuration. An alarm (trap) can only be sent if at least one recipient is entered under *Configuring Traps Using the Web-Based Interface, p. 145* and if both the appropriate status andPort Security are marked.

Defining MAC-Based Port Access Control Using the Web-Based Interface

Define the MAC-based port access control as follows:

Step	Action
1	Connect the ESM to an Ethernet cable.
2	Open the Web-Based Interface.
3	Go to Security → Port Security. The following dialog box appears. 

Module	Port	Port Status	Allowed MAC-Address	Current MAC-Address	Allowed IP-Address	Action
1	1	enabled	00:00:00:00:00:00	00:00:00:00:00:00	0.0.0.0	none
1	2	enabled	00:00:00:00:00:00	00:00:00:00:00:00	0.0.0.0	none
1	3	enabled	00:00:00:00:00:00	00:00:00:00:00:00	0.0.0.0	none
1	4	enabled	00:00:00:00:00:00	00:E0:18:95:D8:61	0.0.0.0	none
2	1	enabled	00:00:00:00:00:00	00:00:00:00:00:00	0.0.0.0	none
2	2	enabled	00:00:00:00:00:00	00:00:00:00:00:00	0.0.0.0	none
2	3	enabled	00:00:00:00:00:00	00:00:00:00:00:00	0.0.0.0	none
2	4	enabled	00:00:00:00:00:00	00:0D:60:6F:1E:E0	0.0.0.0	none

Step	Action
4	Choose MAC-Based Port Security.
5	In the Allowed MAC Address column, enter the MAC address of the device with which data exchange is permitted at this port. Without an entry, data can be received from any device.
6	Press the left mouse button to copy an entry from the Current MAC Address column into the Allowed MAC Address column. The Current MAC Address column shows the MAC address of the device from which data was received last.
7	In the Action column, select one of the following reactions to an unauthorized access attempt: ● no action none ● message by sending a trap trapOnly ● the respective port in the Port Configuration table is disabled (*p. 61*) and trap portDisabled is sent. An entry in the Port Configuration table is part of the configuration and is saved with the configuration. An alarm (trap) can only be sent if at least one recipient is entered under *Configuring Traps Using the Web-Based Interface, p. 145* and if both the appropriate status and Port Security are marked.

Synchronizing the System Time of the Network

7

Protocols for Synchronizing the System Time of the Network

SNTP and PTP

When you synchronize the system time of the network, the ESM allows you to use either the Simple Network Time Protocol (SNTP) or the Precision Time Protocol (PTP). The accuracies of both protocols differ.

If you only require accuracies in the order of milliseconds, the Simple Network Time Protocol (SNTP) offers a low-cost solution.

Areas of application of this protocol are:

- log entries
- time stamping of production data
- production control

The Precision Time Protocol (PTP), which is described in the IEEE 1588 standard, achieves accuracies in the order of fractions of microseconds.

Note: Choose the protocol which best meets your requirements. When using both protocols at the same time, bear in mind that they interact.

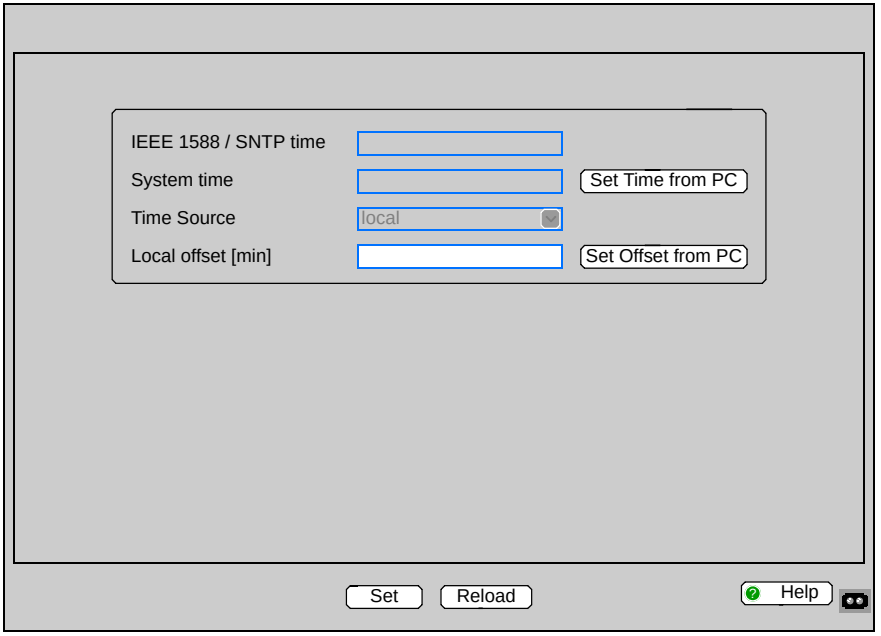
Entering the System Time

Entering the System Time Using PTP or SNTP

If there is no reference watch available, you can enter the system time in the ESM so that you can use it like a reference clock (*p. 83*).

Making Time-Related Settings Using the Web-Based Interface

Make settings independent of PTP or SNTP as follows:

Step	Action
1	Connect the ESM to an Ethernet cable.
2	Open the Web-based interface.
3	Go to Time.
4	Make your time-related settings in the screen below. 

Possible Time-Related Settings

You can make the following settings independent of PTP or SNTP:

- IEEE 1588 Time displays the time received via PTP. SNTP Time displays the time with reference to Universal Time Coordinated (UTC). This means the same time is displayed worldwide and that differences are not taken into account.
- System Time uses IEEE 1588/SNTP time, allowing for the local time difference of IEEE 1588/SNTP time:
  System Time= IEEE 1588/SNTP time + Local offset.
- Time Source displays the origin of the following time. The ESM automatically selects the source with the highest precision.
- If you click Set Time from PC, the switch will load the PC's time as the system time and calculate IEEE 1588/SNTP time, allowing for the local time difference. IEEE 1588/SNTP time = System time - Local offset.
- Local offset allows you to display/enter the time difference between local time and IEEE 1588/SNTP time.
- If you click Offset from PC, the switch will calculate the time zone on your PC, on the basis of which it will calculate the local time difference.

Note: When setting the time zones with summer and winter times, make an adjustment for the local offset. The switch can also receive the IP address of the SNTP server as well as the local offset from a DHCP server.

Setting the System Time and Entering Differences Between IEEE 1588 and SNTP Time Using the CLI

Set the system time and enter the difference between SNTP and IEEE 1588 as follows:

Step	Action
1	Connect the ESM to a serial cable.
2	Open the CLI.
3	Enter the enable command to change to the privileged EXEC mode.
4	Enter the configure command to change to the configuration mode.
5	Enter the sntp time <YYYY-MM-DD HH:MM:SS> command to set the switch system time.
6	Enter the sntp client offset <-1000 to 1000> command to enter the time offset between local time and IEEE1588/SNTP Time.

Simple Network Time Protocol (SNTP)

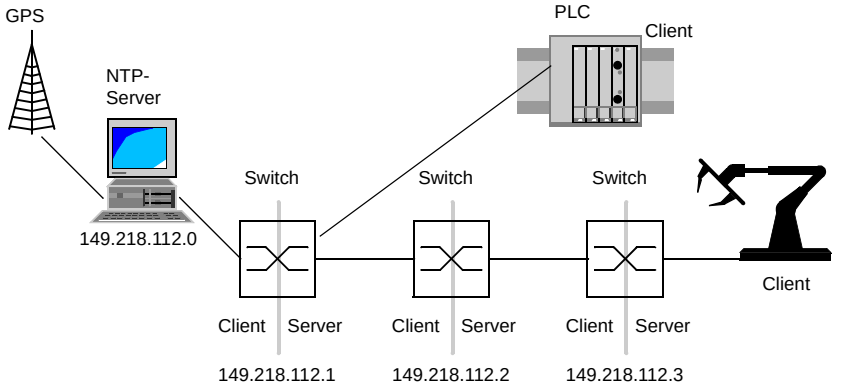
Description of SNTP

SNTP has a hierarchical structure. The SNTP server provides Universal Time Coordinated (UTC). UTC is the time which is referenced to SNTP. The same time is displayed worldwide.

Local time differences are not taken into account.

The ESM supports the SNTP server and the SNTP client functions.

The figure below shows a SNTP application example.



Preparing the SNTP Configuration

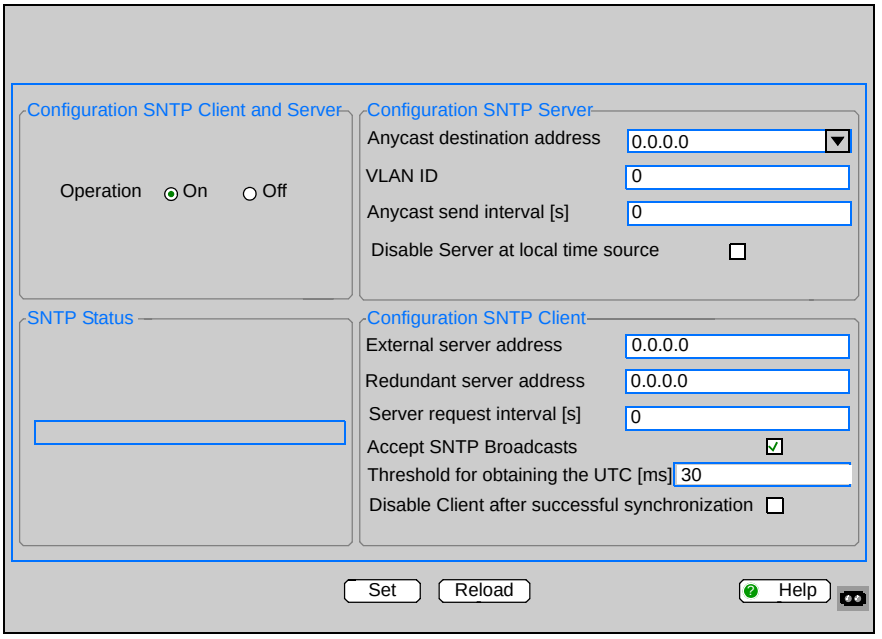
Prepare the configuration as follows:

Step	Action
1	To gain an overview of how the system time is passed on, draw a network plan which shows all devices involved in SNTP. Please bear in mind that the accuracy of the system time depends on signal running time.
2	Switch on the SNTP function on all devices whose time you want to set using SNTP.
3	If you do not have a reference clock at your disposal, use a switch as the reference clock, and set its system time as accurately as possible.

Note: To ensure the most accurate system time distribution possible, do not use network components (routers, switches) which do not support SNTP in the signal path between the SNTP server and the SNTP client.

Configuring SNTP

Configure the SNTP as follows:

Step	Action
1	Connect the ESM to an Ethernet cable.
2	Open the Web-based interface.
3	Go to Time → SNTP. The figure below shows the SNTP dialog. 
4	In the Configuration SNTP Client and Server group box, switch the SNTP function on or off. When it is switched off, the SNTP server does not send any SNTP packages and does not reply to any SNTP requests. The SNTP client does not send any SNTP requests and does not interpret any broadcast/multicast packages.
5	Go to the SNTP Status group box to view server messages such as Server cannot be reached.

Step	Action
6	Go to the Configuration SNTP Server group box, and enter under Anycast destination address the IP address to which the SNTP server on the switch sends the SNTP data packets (target address: 255.255.255.255, the SNTP packets are broadcast). Target address: 224.0.1.1, the SNTP packets are sent to the multicast.
7	Go to the Configuration SNTP Server group box, and specify under VLAN ID the VLAN to which the ESM may periodically send SNTP packets.
8	Go to the Configuration SNTP Server group box, and specify under Anycast send interval the interval at which the ESM sends SNTP packets (valid entries: 1 second to 3600 seconds, default: 120 seconds).
9	Go to the Configuration SNTP Server group box, and observe the state of the Disable Server at local time source check box. When it is selected, the ESM disables the SNTP server function if the status of the time source is local (*p. 80*).
10	Go to the Configuration SNTP Client group box, and enter under External server address the IP address of the SNTP server from which the switch periodically obtains the system time.
11	Go to theConfiguration SNTP Client group box, and enter under Redundant server address, enter the IP address of the SNTP server from which the ESM periodically obtains the system time if the ESM does not receive an answer from the External Server Address within 0.5 seconds after making the query. **Note:** If you receive the system time from an external/redundant server address, do not accept any SNTP broadcasts. Otherwise you do not know whether the ESM displays the time from the server entered, or the time from an SNTP broadcast package.
12	Go to the Configuration SNTP Client group box, and specify under Server request interval the interval at which the ESM requests SNTP packages (valid entries: 1 second to 3600 seconds, default 30 seconds).
13	Click Accept SNTP Broadcasts if you want the ESM to obtain the system time from SNTP broadcast/ multicast packages which it receives.
14	Go to the Configuration SNTP Client group box, and enter a value in ms under Threshold for obtaining the UTC [ms]. This is used to reduce the frequency of time alterations. The ESM obtains the UTC as soon as the deviation to the server time is above or below this threshold.
15	Click Disable Client after successful synchronization if you want the ESM to have no further time synchronizations after it has adjusted its time with the server.

Configuration Example

The following table shows a configuration example:

Switch	**149.218.112.1**	**149.218.112.2**
Operation	On	On
Any cast destination address	224.0.1.1	224.01.1
Server VLAN ID	1	1
Anycast Send Interval	120	120
Client External Server Address	149.218.112.0	149.218.112.1
Server Request Interval	30	30
Accept SNTP Broadcasts	No	No

Precision Time Protocol (PTP)

Function Description of PTP

The requirement for running time-critical applications over a LAN is a precision time management system. The IEEE 1588 standard with the Precision Time Protocol describes a procedure that is based on the reference clock principle. This means that the clocks in a LAN are synchronized according to the most precise clock reference or grandmaster clock) in that LAN.

This procedure permits synchronization of the clocks with an accuracy on the scale of hundredths of nanoseconds. The synchronization messages have virtually no effect on the network load. PTP uses multicast communication.

Factors influencing precision are:

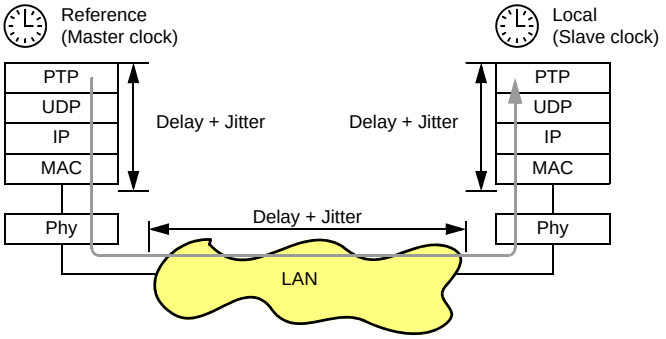
- Accuracy of the Reference Clock IEEE 1588 classifies clocks according to their accuracy. An algorithm that measures the accuracy of the available clocks in the network determines the most accurate time for the grandmaster clock.

The following table explains what some stratum numbers stand for.

Stratum Number	Specification
0	To assign for temporary, special purposes a better value to one clock than to all other clocks within the network.
1	Designates the clock with the highest precision as the reference clock. A stratum 1 clock can be both a boundary and an ordinary clock. Stratum 1 clocks include GPS clocks and calibrated atomic clocks. A stratum 1 clock cannot be synchronized using PTP from another clock in the PTP system.
2	Designates the clock as the second-choice reference clock and cannot be synchronized using PTP from another clock in the PTP system.
3	Designates the clock that can synchronize other devices using an external cable as the reference clock.
4	Designates the clock as the reference clock.
5-254	Reserved
255	Default Setting (Such a clock should never be the best master clock).

- Cable Delays; Device Delays
  The communication protocol defined by IEEE 1588 allows you to measure cable delays. Formulas for calculating the current time eliminate delays.
- Accuracy of Local Clocks
  The communication protocol defined by IEEE 1588 takes into account the inaccuracy of local clocks relative to the reference clock. Calculation formulas permit the synchronization of local time, allowing for the inaccuracy of the local clock relative to the reference clock.

The figure illustrates delay and jitter problems when synchronizing clocks.

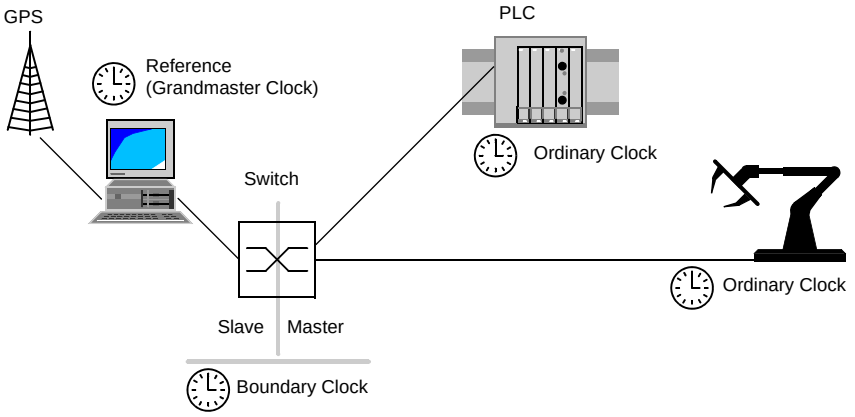


To get around the delay and jitter in the protocol stack, IEEE 1588 recommends inserting a special hardware time stamp unit between the MAC and the PHY layer. Devices or modules with the name supplement **RT** are equipped with a time stamp unit.

The delay and jitter in the LAN increases in the media and transmission devices along the transmission path.

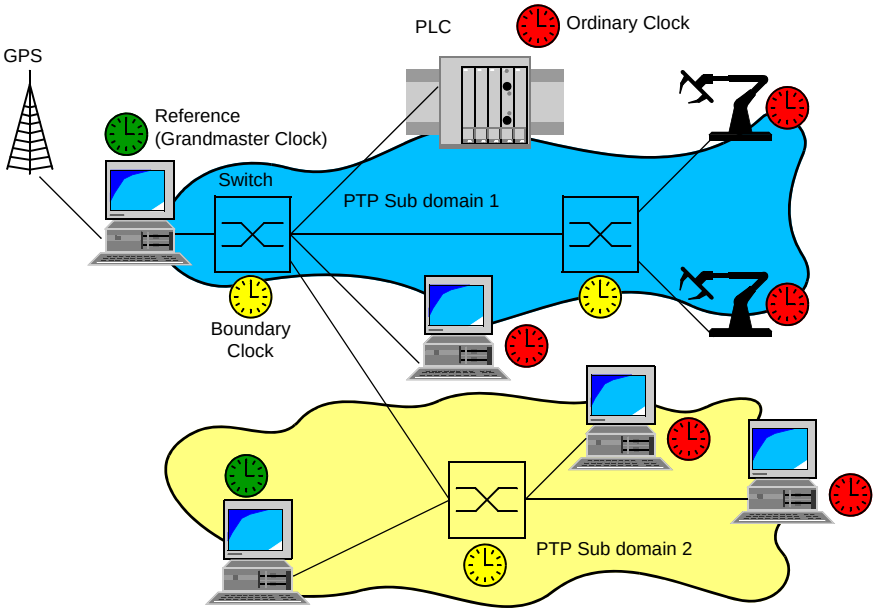
The cable delays are relatively constant. Changes occur very slowly. This fact is taken into account by IEEE 1588. So measurements and calculations are performed on a regular basis.IEEE ignores the inaccuracy caused by device delays and device jitter by defining boundary clocks. Boundary clocks are clocks that are integrated into the devices. These clocks are synchronized on one side of the signal path and, on the other side of the signal path, they are used to synchronize the subsequent clocks (ordinary clocks).

The following figure illustrates how a boundary clock works.



Independent of the physical communication paths, PTP provides logical communication paths you define when you set up PTP subdomains. Subdomains are designed to create groups of clocks that are time-independent of the rest of the domain. Typically, the clocks use the same communication paths that other clocks use.

The following figure illustrates how subdomains work.



Setting Up Your Network and Enabling PTP

You can set up your network and enable PTP as follows:.

Step	Action
1	Draw a network plan showing all devices involved in PTP.
2	Connect all connections you need to distribute PTP information to devices equipped with an integrated time stamp unit (RT modules). Devices which are not equipped with a time stamp unit obtain the PTP information and set their clocks accordingly. They are not involved in the protocol.
3	Connect all devices to Ethernet cables.
4	Open the Web-based interface.
5	Go to Time → PTP.
6	Select On to enable the PTP function on all devices whose time you want to synchronize using PTP.
7	Click Set to retain your setting.
8	If there is no reference clock available, designate a switch as reference clock, and set the system time as precisely as possible.

Interaction between PTP and SNTP

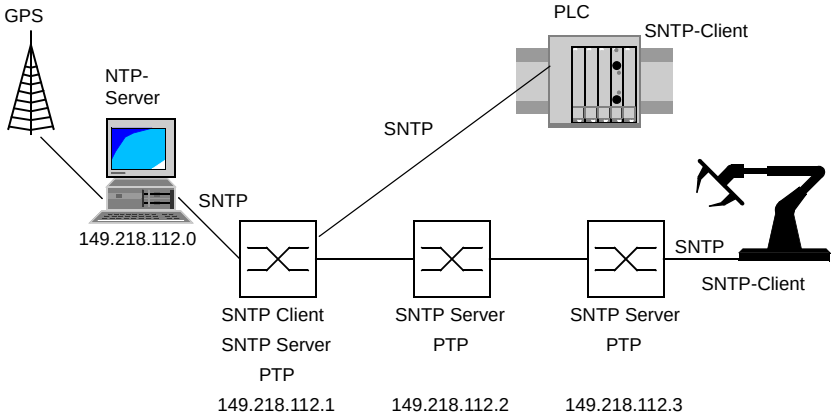
Suggested Configuration of Devices

PTP and SNTP permit each other to coexist in one network. However, since both protocols influence the system time of the device, situations may occur in which they compete with each other.

> **Note:** Configure the devices in such a way that each device receives the system time exclusively from one source. If you want the switch to receive the system time using PTP, enter the external server address 0.0.0.0, and do not accept any SNTP broadcasts when performing the SNTP client configuration. If you want the switch to receive the system time using SNTP, make sure that the best clock is connected to the SNTP server. Thus, both protocols receive the time from the same server.

Application Example

This figure shows an application example of the coexistence of PTP and SNTP.



The requirements made to network time accuracy are rather high, however the end devices exclusively support SNMP, which is less precise than PTP. SNTP achieves an accuracy of milliseconds, whereas PTP has an accuracy of fractions of microseconds (see fig. above).

The following table shows an application example.

Switch	**149.218.112.1**	**149.218.112.2**	**149.218.112.3**
PTP			
Function	On	On	On
Clock Mode	PTP Mode Boundary Clock	PTP Mode Boundary Clock	PTP Mode Boundary Clock
Preferred Master	False	False	False
SNTP			
Function	On	On	On
Anycast Destination Address	224.0.1.1	224.0.1.1	224.0.1.1
Server VLAN ID	1	1	1
Anycast Send Interval	30	30	30
Client External Server Address	149.218.112.0	0.0.0.0	0.0.0.0
Server Request Interval	Any	Any	Any
Accept SNTP Broadcasts	No	No	No

In the example above, the left switch receives as the SNTP client the system time from the NTP server using SNTP. The switch assigns to a time received from an NTP server the stratum clock number 2 (*p. 86*). Thus, the left switch becomes the reference clock for PTP synchronization. PTP is active in all three switches, ensuring that, relative to each other, the system times of the switches are synchronized precisely. As the connectable end devices in the example exclusively support SNTP, all three switches serve as SNTP servers.

Network Load Control

8

Directed Frame Forwarding

Directed Frame Forwarding Functions

Directed frame forwarding is a method used by the ESM switch to avoid unnecessary increases in the network load. The switch features the following directed frame forwarding functions:

- store-and-forward
- multi-address capability
- removal of aged learned addresses
- static address entries

Store-and-Forward

All data received by a ESM switch are stored, and their validity is checked. Invalid and defective tagged frames (> 1522 bytes or CRC status messages) as well as fragments (< 64 bytes) are discarded. Only valid tagged frames are forward by the ESM.

Multi-Address Capability

An ESM switch learns all the source addresses for a port and is capable of learning up to 8,000 addresses. Only frames with:

- unknown addresses
- these addresses or
- a multi/broadcast address

in the destination address field are sent to this port.

The ESM floods data packets with an unknown destination address.

The ESM directly distributes data packets with a known destination address.

The ESM enters learned source addresses in its filter table.This becomes necessary if more than one terminal device is connected to one or more ports. It is thus possible to connect several independent subnetworks to an ESM.

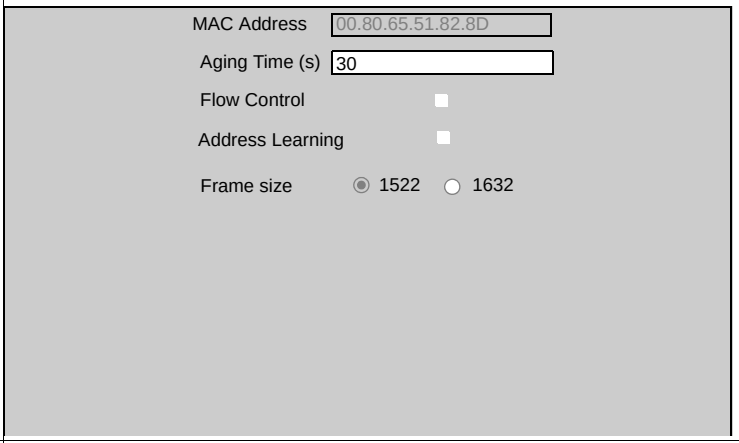
Removal of Aged Learned Addresses

The ESM monitors the age of the learned addresses in its filter table. Learned address entries which exceed 30 seconds of aging time are deleted by the ESM from its filter table.

Note: A reboot deletes the learned address entries.

Entering the Aging Time in the Web-Based Interface

Enter the aging time as follows:

Step	Action
1	Connect the ESM to an Ethernet cable.
2	Open the Web-based interface.
3	Go to Switching → Global to open the Switching Global dialog box. 
4	Enter the Aging Time (s) for all dynamic entries in the range from 10 to 630 seconds (Unit: 1 second, default setting: 30).
5	Click Set to apply the aging time of all learned addresses.

Filter Function

One of the most important functions of an ESM switch is the filter function. It selects tagged frames according to certain defined patterns called filters. These patterns are associated with switching rules. This means that a tagged frame received at the port of a switch is compared to the patterns. If a pattern matches the tagged frame, the switch will either transmit or reject the packet according to the switching rules for the affected ports.

The following are valid filter criteria:

- destination address,
- broadcast address,
- multicast address,
- VLAN membership.

The individual filters are stored in the Forwarding Database (FDB) filter table. The table is divided into three parts, a static part and two dynamic parts.

- The management administrator describes the static part of the filter table (dot1qStaticTable).
- During operation, the ESM switch is capable of learning which ports will receive tagged frames from which source addresses. This information is stored in the dynamic part of the table (dot1qTpFdbTable)
- Addresses learned from the neighboring agent and those learned by GMRP are written to another dynamic part.

Addresses already located in the static filter table are automatically transferred by the switch into the dynamic part.

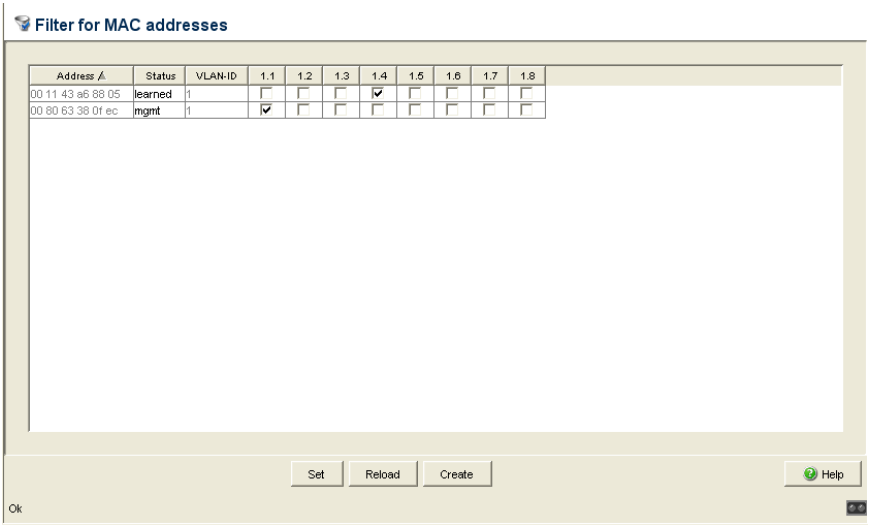
An address entered statically cannot be overwritten through learning.

Note: If the redundancy manager is active, it is not possible to make permanent unicast entries.

Note: In the filtering database, you can create up to 100 filters for multicast addresses.

Assigning Filter Addresses

You assign filter addresses with the Filter for MAC addresses dialog box (shown below).



Each row of the table represents one filter. Filters specify the way in which data packets (frames) are sent. The filters are derived in either of two ways:

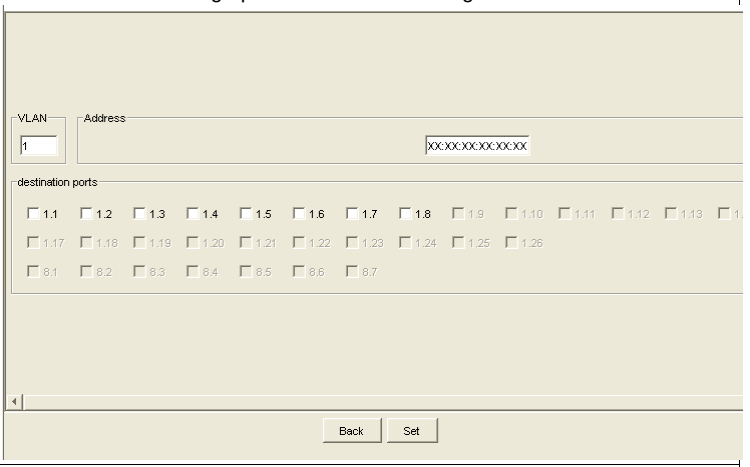
- created manually
- set automatically (learned status)

Those data packets whose destination address is manually entered in the table are sent from the receiving port to the ports marked in the table.

Those data packets whose destination address is not entered in the filter table (set automatically) are sent from the receiving port to all other ports.

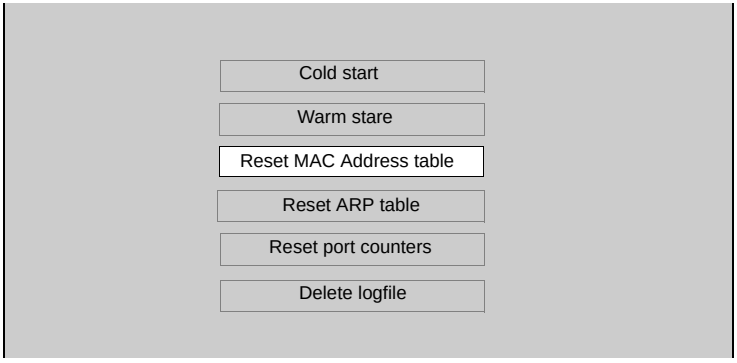
Entering Static Addresses

You assign filter address with the Filter for MAC addresses dialog box.

Step	Action
1	In the tree view of the web-based interface, select Switching → Filters for MAC addresses to bring up the dialog box (shown above).
2	Click on Create to bring up the Create Filter dialog box. 
3	Type in the address of the desired filter in the Address box.
4	Click on the appropriate port number in the destination ports box.
5	Click on Set to create the filter and return to the Filters for MAC addresses dialog box.
6	Repeat steps 2 to 5 to create each additional required filter.

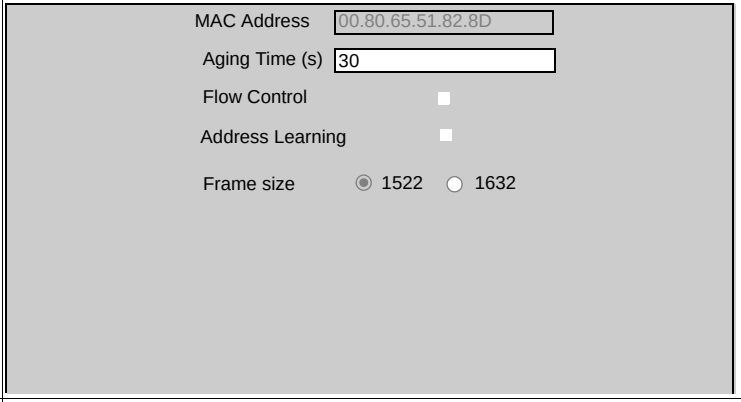
Deleting Learned Address Entries

You can delete address entries with learned status from the filter table as follows:

Step	Action
1	In the tree view of the web-based interface, select Basics → Restart to bring up the Restart dialog box.
2	Click on Reset MAC Address table. 

Disabling the Directed Frame Fowarding

The ESM switch allows you to disable the learning of addresses and observe the data at all the ports. When this occurs, the ESM transfers all the data from all ports to all ports. To disable address learning:

Step	Action
1	In the tree view of the web-based interface, select Switching → Global to bring up the Global dialog box.
2	Click on Address Learning. 
3	Click on Set.

Multicast Application

Description of Multicast Application

The data distribution in the LAN distinguishes between three distribution classes with reference to the addressed recipient:

- unicast (one recipient)
- multicast (a group of recipients)
- broadcast (every recipient that can be reached)

In the case of a multicast address, switches pass all data packets with a multicast address to all ports in the multicast group. This leads to an increased bandwidth requirement.

Protocols such as GMRP and processes such as IGMP Snooping enable the switches to exchange information by means of the targeted distribution of multicast data packets. The distribution of the multicast data packets exclusively to those ports to which the recipients of these multicast data packets are connected, reduces the bandwidth required.

You can recognize IGMP multicast addresses by the area in which an address is located:

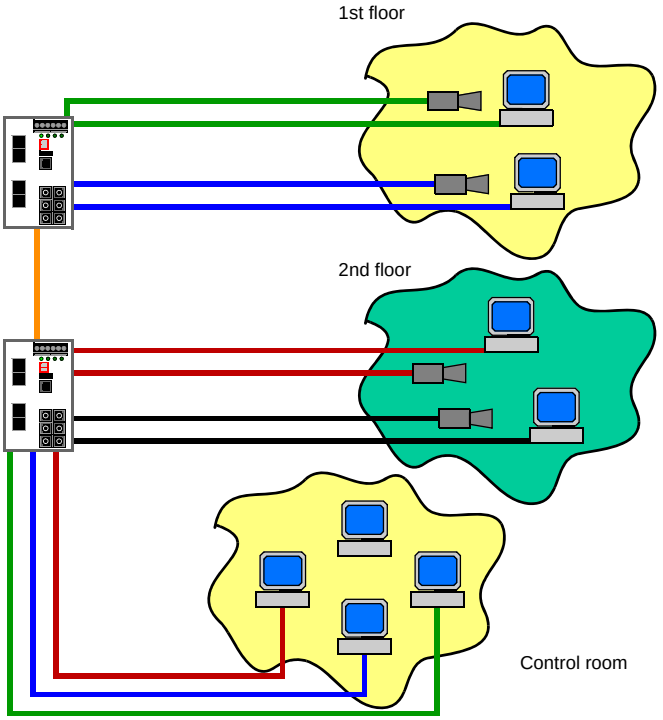
- MAC multicast address (01:00:5E:00:00:00 - 01:00:5E:FF:FF:FF)
- IP multicast address class D (224.0.0.0 - 239.255.255.255)

Example of a Multicast Application

The cameras for machine surveillance normally transmit their images to monitors located in the machine room and in the monitoring room. In an ESM IP transmission, a camera sends its image data with a multicast address over the network.

To prevent the many images from slowing down the entire network, the ESM uses the GMRP to distribute multicast address information. As a result, those images with a multicast address are only distributed to those ports that are connected to the associated monitors for surveillance.

The figure shows a multicast application example.



Description of IGMP Snooping

The Internet Group Management Protocol (IGMP) describes the distribution of multicast information between routers and end devices on layer 3.

Routers with an active IGMP function periodically send queries to find out which IP multicast group members are connected to the LAN.

Multicast group members reply with a report message. This report message contains all parameters required by the IGMP. The router records the IP multicast group address from the report message in its routing table. Then the router transfers frames with this IP multicast group address in the target address field only in accordance with the routing table.

Devices that no longer want to be members of a multicast group can cancel their membership with a Leave message (from IGMP version 2), and they do not transmit any more report messages. In IGMP versions 1 and 2, the router removes the routing table entry if it does not receive any report messages within a specified period of time (aging time). If there are a number of routers with an active IGMP function in the network, then they work out among themselves which router carries out the query function when using IGMP version 2. If there is no router in the network, a suitably equipped switch can carry out the query function.

A switch that connects a multicast receiver with a router can evaluate the IGMP information with the aid of the IGMP Snooping procedure.

IGMP Snooping translates IP multicast group addresses into MAC multicast addresses, so that the IGMP functions can also be used by layer 2 switches. The switch records the MAC addresses of the multicast receivers, which are obtained by the IGMP snooping from the IP addresses, in the static address table. Thus the switch blocks multicast packets at those ports to which no multicast receivers are connected.

Description of GMRP

The GARP Multicast Registration Protocol (GMRP) describes how multicast information is distributed to other switches on layer 2 level. Thus switches can learn multicast addresses. When a multicast address is entered in the static address table, the ESM sends this information to all ports. This tells the connected switches to pass this multicast address on to this switch.

The GMRP describes the distribution of data packets with a multicast address as the target address. Devices that want to receive data packets with a multicast address as the target address carry out the registration of the multicast address with the aid of the GMRP. For a switch, registration involves entering the multicast address in the filter table. When a multicast address is entered in the filter table, the switch sends this information in a GMRP packet to all the ports. Therefore the connected switches know that they have to send this multicast address to this switch. The GMRP enables packets with a multicast address in the target address field to be sent to the ports entered. The other ports are not affected by these packets.

Data packets with unregistered multicast addresses are sent to all ports by the switch

Default setting: GMRP Enabled

Devices that do not support GMRP can be integrated into the multicast addressing scheme by means of a static filter address entry on the connector port.

The multicast tree is set up within 5 seconds in a network of up to 20 ESM modules, after the multicast address has been entered for the first time at an ESM port. This time period depends on the *Join Time* that is set (default setting = 200 ms).

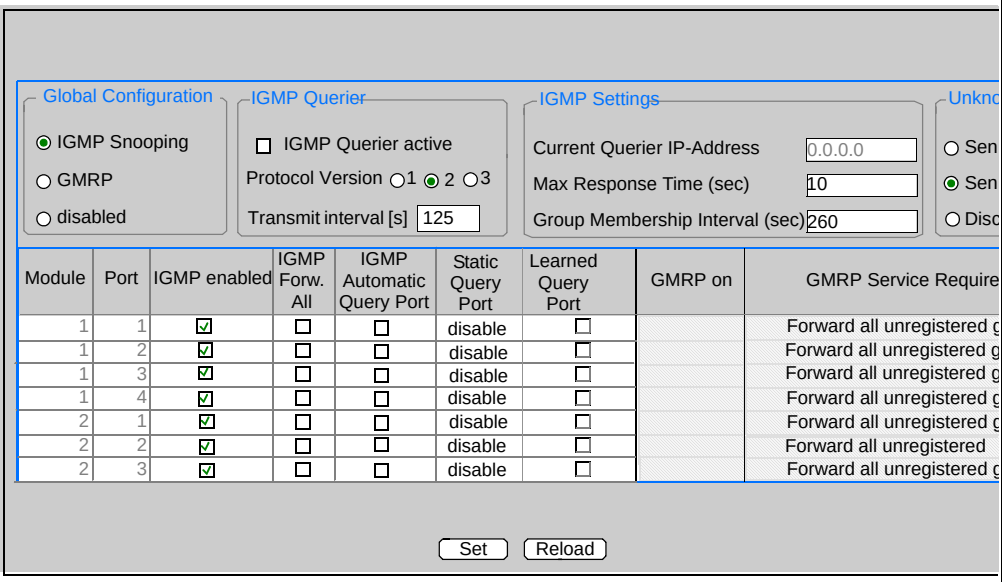
Setting Up Multicast Applications

You setup multicast applications consisting of the IGMP snooping process and the GMRP protocol on the ESM through the use of the Multicast dialog box. The following discussions describe the settings available on the Multicast dialog box to configure the ESM to support both these multicast applications.

Global Settings

The Global Configuration section of the Multicast dialog box allows you to globally enable and disable the IGMP snooping and GMRP functions for the entire ESM. In order to gain access to these selections, proceed as follows:

Step	Action
1	Connect the ESM to an Ethernet cable.
2	Open the Web-based interface.
3	Go to Switching → Multicasts.
4	Click on IGMP Snooping to display the Multicasts dialog box with the global IGMP Snooping function switched on.



5	If the IGMP snooping is switched off ● the switch does not evaluate query and report packets received, and ● it sends (floods) received data packets with a multicast address as the target address to all ports.
6	Click on GMRP to turn GMRP on and off globally for the switch (*p. 108*).
7	Click on disabled to disable IGMP Snooping and GMRP.

IGMP Global Settings

IGMP Snooping allows you to enable IGMP snooping for the entire ESM.

If IGMP Snooping is disabled, then:

- the switch does not evaluate query and report packets received, and
- it sends (floods) received data packets with a multicast address as the target address to all ports.

The following discussions explain the various selections on the Multicast dialog box that are available in the IGMP global mode.

IGMP Querier

The IGMP Querier section provides options for performing the query function as described below.

IGMP Querier active

Use this check box to switch the query function on/off.

Protocol Version

This option allows you to select IGMP protocol version 1, 2 or 3.

Note: If you use IGMP version 1 in a subnetwork, then you must also use IGMP version 1 in the entire network. Also, If a number of routers are connected to a subnetwork, you must use IGMP version1, so that all the routers receive all the IGMP reports.

Transmit Interval [s]

Here you enter the interval at which the device sends query packets. The interval can range between 2 to 3599 s (seconds), and the default is set to 125 s.

All IGMP-capable terminal devices respond to a query with a report message, which increases the network traffic load. If you want to reduce this load factor, select large sending intervals but be aware that this will result in longer switching times.

If you want short switching times, select small sending intervals as long as you can accept the increased network load.

IGMP Settings

The IGMP Settings section provides options for response time and interval periods for multicast group members responding to queries.

Current Querier IP-Address

Indicates the IP address of the router that has the query function.

Max Response Time (sec)

Here you specify the period within which the Multicast group members respond to a query. The period can range between 1 to 3598 seconds (sec), and the default is set to 10 sec. Try to select a random values for their response to prevent all the multicast group members from responding to the query at the same time.

Select a larger response time if you want to reduce the load on your network and can accept the resulting longer switching times.

Select a smaller response time if you require short switching times and can accept the increased network load.

Group Membership Interval (sec)

Enter a specific period for which a dynamic Multicast group remains entered in the switch if it does not receive any report messages. The period can range between 3 to 3600 seconds (sec), and the default is set to 260 sec.

Unknown Multicasts

This frame provides you with three different selections, when the ESM switch is in the IGMP mode, for sending packets with an unknown MAC/IP Multicast address that was not learned through IGMP snooping. The selections are as follows:

Send to Query Ports

Selecting this option allows the switch to send packets with an unknown MAC/IP Multicast address to all query ports.

Send to All Ports

Selecting this option allows the switch to send packets with an unknown MAC/IP Multicast address to all ports.

Discard

Selecting this option causes the switch to discard all packets with an unknown MAC/IP Multicast address.

Note: The way in which unlearned Multicast addresses are handled also applies to the reserved addresses from the Local Network Control Block 224.0.0.0 thru 224.0.0.255. This can have an effect on higher-level routing protocols.

Known Multicasts

This frame provides you with two different selections, when the ESM switch is in the IGMP mode, for sending packets with a known MAC/IP Multicast address that were learned through IGMP snooping. The selections are as follows:

Send to Query and registered Ports

This option allows the switch to send packets with a known MAC/IP Multicast address to all query ports and to registered ports. The advantage of this selection is that it works in most applications without any additional configuration

Send to Registered Ports

This option allows the switch to send packets with a known MAC/IP Multicast address to registered ports. The advantage of this selection, which deviates from the standard, is that it uses the available bandwidth optimally through direct distribution.

Individual IGMP Port Settings

With in the table portion of the Multicast dialog box are several column selection pertaining to the IGMP mode that are made against individual ports on the ESM. Each of these settings are described below.

IGMP Enabled per Port

This table column allows you to enable/disable the IGMP for each port whenever the global IGMP Snooping is enabled (*p. 103*). No registrations can be made for a port when its check box is unchecked.

IGM Forward All per Port

The IGMP Forw. All table column allows you to switch the Forward All function on/off for each port whenever the global IGMP Snooping is enabled. Selecting the IGMP Forward All check box causes the switch to forward all the data packets with a multicast address in the target address field to this port.

Note: In the case of a ring interruption when the switch is connected to a HIPER ring, you can ensure quick reconfiguration of the network for data packets with registered multicast target addresses by:
- switching on the IGMP both globally and at the ring port, and
- switching on the IGMP Forw. All per port on the port rings.

IGMP Automatic Query per Port

The IGMP Automatic Query Port table column indicates which ports the switch has learned as query ports whenever automatic is selected in theStatic Query Port column (see below).

Static Query per Port

The Static Query Port column of the table can display one of three conditions for each switch port:

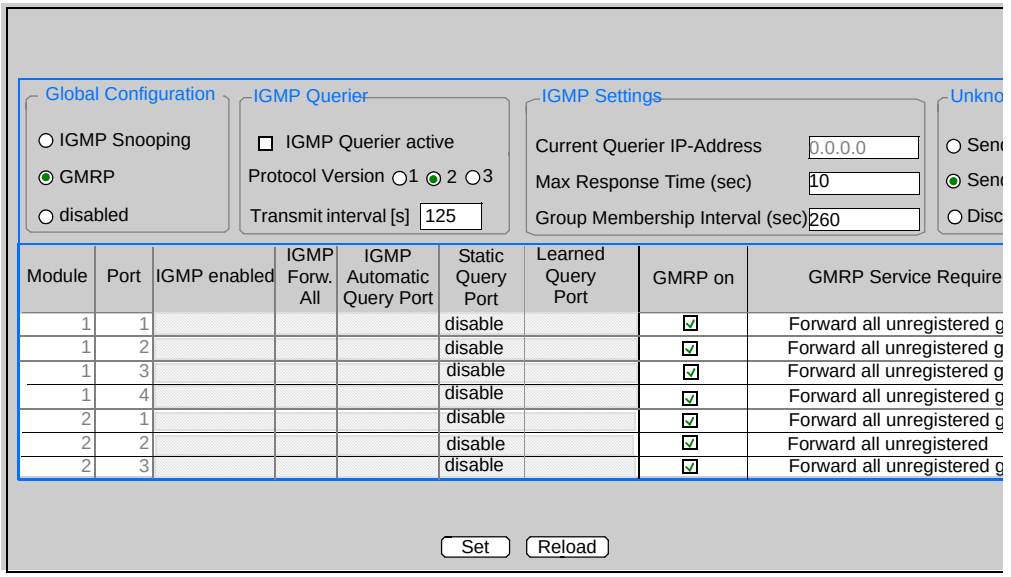
- disabled-switch sends IGMP report messages to the ports at which it receives IGMP queries.
- enabled-switch sends IGMP report messages to other selected ports.
- automatic-switch sends IGMP report messages to other connected ESM switches.

Learned Query per Port

The Learned Query Port column displays the ports on which the switch has received IGMP queries if disable is selected in the Static Query Port table column (see above).

GMRP Global

When you click on GMRP in the Global Configuration section of the Multicast dialog box, it appears as shown below:



When the GMRP is selected, the GMRP function is switched on globally for the entire ESM.

If GMRP is switched off

- the switch does not generate any GMRP packets,
- the switch does not evaluate any GMRP packets received, and discards them, and
- it sends (streams) received data packets with a multicast address as the target address for all ports.

The switch is transparent for received GMRP packets, regardless of the GMRP setting.

Individual GMRP Port Settings

Within the table portion of the Multicast dialog box are two column selections pertaining to the GMRP mode that are made against individual ports on the ESM. Each of these settings are described below.

GMRP on per Port

The GMRP on table column enables you to switch on/off the GMRP for each port when the global GMRP is switched on. When you switch off the GMRP at a port, no registrations can be made for this port, and GMRP packets cannot be sent out of this port.

Note: If the switch is connected to a HIPER ring, in the case of a ring interruption you can ensure quick reconfiguration of the network for data packets with registered multicast target addresses by:

- switching on the GMRP at the ring ports globally, and
- switching on the IGMP Forward All per port on the ring ports

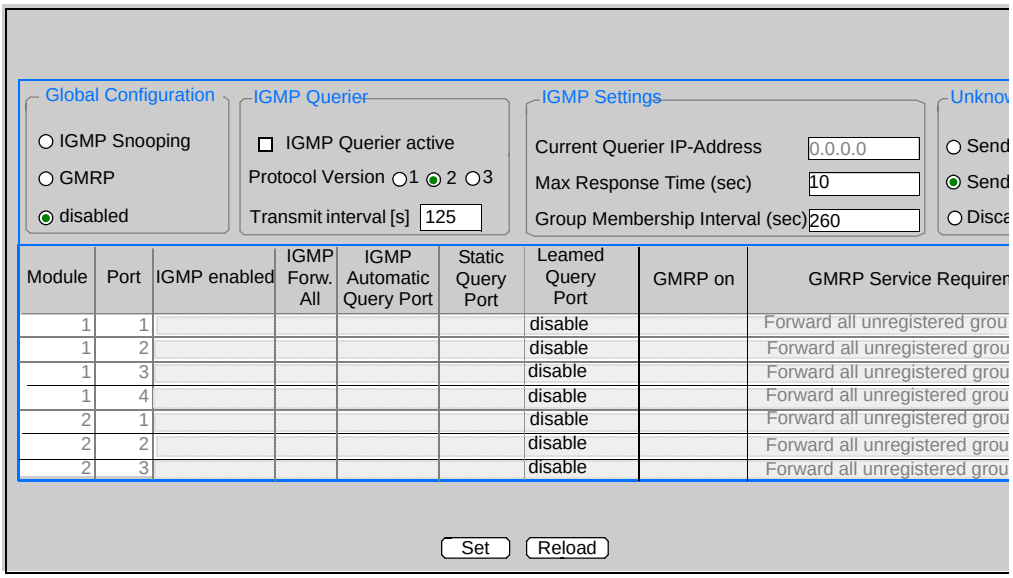
GMRP Service Requirement per Port

Devices that do not support GMRP can be in integrated into the Multicast addressing by means of:

- selecting Forward all groups in the GMRP Service Requirement column. The ESM enters ports with the selection Forward all groups in all Multicast filter entries learned via GMRP.
- a static filter address entry on the connecting port

Disabling Global Settings

When you click on disabled in the Global Configuration section of the Multicast dialog box, it appears as shown below:



When disabled is selected, both the IGMP Snooping and GMRP global functions are deactivated.

The Rate Limiter

Description of the Rate Limiter

To improve the data exchange reliability during high rates of traffic, the ESM switch can limit traffic levels.

By entering a rate limit for each port, the amount of traffic the switch receives or transmits is determined.

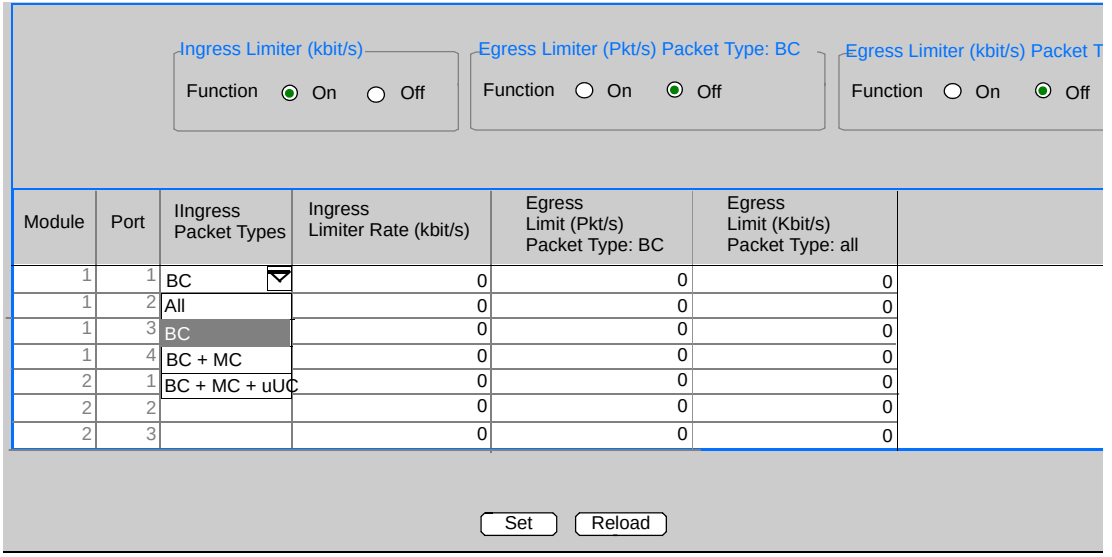
The switch samples the received and transmitted data and will discard data above the max limit.

A global setting activates/deactivates the broadcast limiter function at all ports.

Accessing the Rate Limiter Dialog Box

To access the Rate Limiter dialog box proceed as follows:

Step	Action
1	Connect the ESM to an Ethernet cable.
2	Open the Web-based interface.
3	Go to Switching → Rate Limiter to bring up the Rate Limiter dialog box (shown below).



Selection Options

The three areas across the top of the dialog box allow you to enable or disable the input (ingress) and output (egress) data limits for all the ESM ports. Each of these three areas are related to a particular type of data packet:

- Selecting On in the Ingress Limiter (kbit/s) frame enables the input limiting function for all the ESM ports.
- Selecting On in the Egress Limiter (Ptk/s) Packet Type: BC frame enables the broadcast output limiter function for all the ESM ports.
- Selecting On in the Egress Limiter (kbit/s) Packet Type: all frame enables the output limiter function for all packet types at all the ESM ports.

Selecting Off in any of these frames disables the function.

Individual Port Settings

The individual port settings are configured from the columns in the table of the Rate Limiter dialog box. The Module and Port columns identify the ESM switch (Module) and its associated Ports.

The Ingress Packet Types column contains a drop-down combo box that provides the following packet type selections:

- All: limits the total inbound data volume of the port.
- BC: limits the broadcast packets received at the port.
- BC + MC: limits the broadcast and Multicast packets received at the port.
- BC + MC + uUC: limits the broadcast, Multicast and unknown Unicast packets received at the port.

The Ingress Limiter Rate (kbit/s) column sets the limit for the inbound packet type. Either of two values can be entered:

- 0: no ingress limit at this port (this is the default setting).
- A value > 0: maximum inbound traffic rate in kbit/s that can be received at the port.

The Egress Limiter (Ptk/s) Packet Type: BC column sets the limit for broadcast packets. Either of two values can be entered:

- 0: no rate limit for outbound broadcast packets at this port (this is the default setting).
- A value > 0: maximum number of outbound broadcast packets per second that can be sent at the port.

The Egress Limiter (kbit/s) Packet Type: all column sets the limit for the entire data stream. Either of two values can be entered:

- 0: no rate limit for the outbound data stream at this port (this is the default setting).
- A value > 0: maximum outbound transmission rate in kbit/s that can be sent at the port.

QoS/Priority

Descripton of Prioritization

The Quality of Service (QoS) function prevents high-priority time-critical data traffic such as language/video or real-time data from being disrupted by less critical traffic during busy periods. By assigning high traffic classes for time-critical data and low traffic classes for less time-critical data, you ensure optimal data flow for time-critical data traffic.

The ESM supports four priority queues (traffic classes in compliance with IEEE 802.1D). The assignment of received data packets to these classes depends on

- The priority of the data packet contained in the VLAN tag when the receiving port was configured to "trust dot 1p".
- The QoS information (ToS/DiffServ) contained in the IP header when the receiving port was configured to "trust ip-dscp".
- The port priority when the port was configured to "no trust".
- The port priority when receiving non-IP packets when the port was configured to "trust ip_dscp".
- The port priority when receiving data packets without a VLAN tag and when the port was configured to "tust dot 1p".

The ESM considers the classification mechanisms in the sequence listed above.

Data packets can contain prioritizing/QoS information in accordance with:

- VLAN priority based on IEEE 802.1Q/802.1d (Layer 2)

VLAN Tagging

The VLAN tag is integrated into the MAC data frame for the VLAN and prioritization functions in accordance with the IEEE 802.1 Q standard. The VLAN tag consists of 4 Bytes. It is inserted between the source address field and the type field.

For data packets with a VLAN-tag, the ESM evaluates:
- the priority information at all times, and
- the VLAN information, if VLANs have been set up.

Data packets with VLAN tags that contain priority information but no VLAN information (VLAN ID = 0) are called priority tagged frames

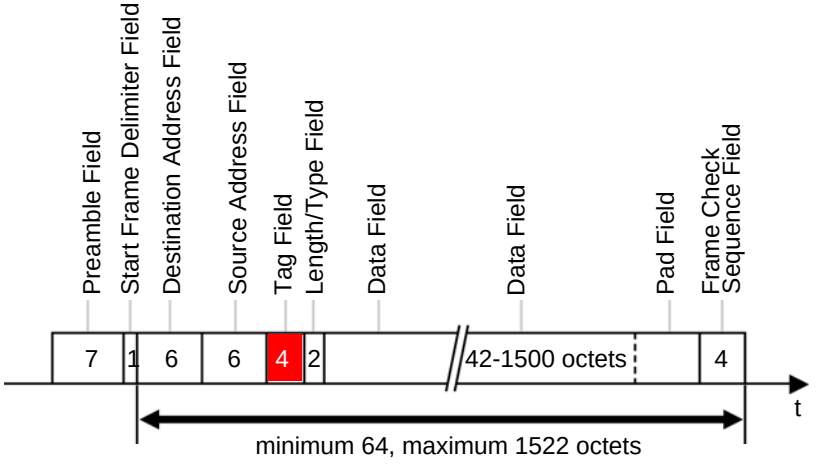
Assignment of Priorities

The assignment of the priority entered in the tag to the four priority classes is as follows:

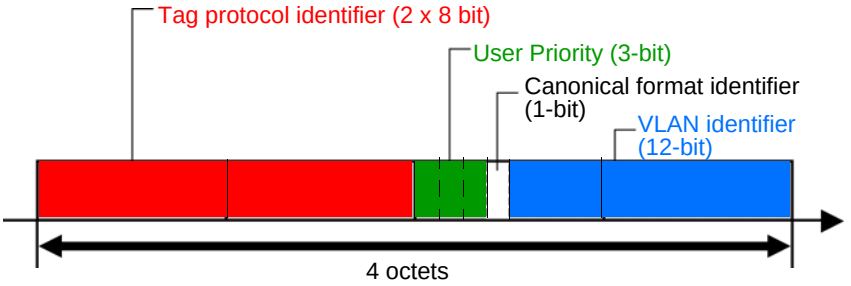
Entered Priority	Priority Class	IEEE 802.1D Traffic Type
0	1 - normal	Best effor (default)
1	0 - low	Background
2	0 - low	Standard
3	1 - normal	Excellent effort (business critical)
4	2 - high	Controlled load (streaming multimedia)
5	2 -high	Video; less than 100 milliseconds delay
6	3 - admin	Video; less than 10 milliseconds delay
7	3 - admin	Network control

Note: Network protocols and redundancy mechanisms use the highest traffic class 3. Therefore, you must select other traffic classes for application data.

An Ethernet data packet with a tag is shown in the following figure:



The format of the tag field is shown in the following figure:

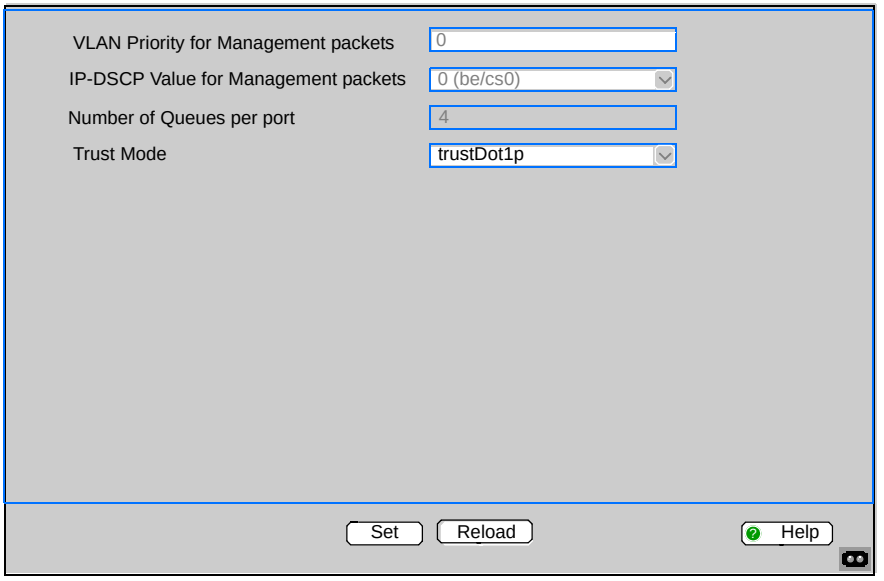


Although VLAN prioritizing is widespread in the industry sector, it has a number of limitations:

- The additional 4-byte VLAN tag enlarges the data packets. With small data packets, this leads to a larger bandwidth load.
- End-to-end prioritizing requires the VLAN tags to be transmitted to the entire network, which means that all network components must be VLAN-capable.
- Routers cannot receive or send packets with VLAN tags via port-based router interfaces.

The Global Dialog

The QoS/Priority Global dialog box is shown below



With this dialog you can do the following:

Enter the VLAN Priority for Management packets inthe range 0 to 7 (default setting is 0)

- In order for you to have full access to the management of the switch, even when there is a high network load, the switch enables you to priotize management packets.
- In prioritizing mamagement packets (SNMP), Telnet, and so on), the switch sends the management packets with priority information.

Note the assignment of the VLAN priority to the traffic class (*p. 114*).

Enter the IP-DSCP Value for Management packets in the range 0 to 63 (default setting is 0 (be/cs0)).

- In order for you to have full access to the management of the switch, even when there is a high network load, the switch enables you to priotize management packets.
- In prioritizing mamagement packets (SNMP), Telnet, and so on), the switch sends the management packets with priority information.

Note the assignment of the VLAN priority to the traffic class (*p. 114*).

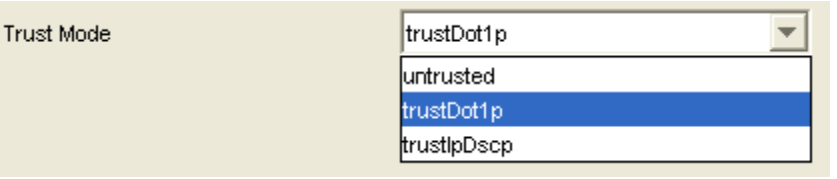
Note: Certain DSCP values have DSCP names, such ad be/cs0 to cs7 (class selector) or af11 to af43 (assured forwarding) and ef (expedited forwarding).

Display the maximum Number of Queues per port possible per port.

- The switch supports four priority queues (traffic classes in compliance with IEEE 802. 1D).

Assigning Priorities to Received Data packets

Select the Trust Mode globally. You use this to specify how the switch handles received data packets that contain priority information.To accomplish this, the ESM provides three options that you can choose globallly for all ports. These options are selectable from theTrust Mode list (available by clicking on the scroll bar) shown below.



The three options are descirbed as follows:

untrusted:

- The switch ignores the priority information in the packet and always assigns the packets the port priority of the receiving port.

trustDotIp:

- The switch prioritizes received packets that contain VLAN tag information (assigning them to a traffic class-see 802. 1D/p Mapping) in accordance with this information.
- The switch prioritizes received packets that contain no tag information (assigning them to a traffic class (*p. 119*)) in accordance with the port priority of the received port.

trustIpDscp:

- The switch prioritizes received IP packets (assigning them to a traffic class-see IP DSCP Mapping) in accordance with their DSCP value.
- The switch prioritizes received packets that are not IP packets (assigning them to a traffic class-see Entering the port priority) in accordance with the port priority of the receiving port.

VLAN Priority Remarking

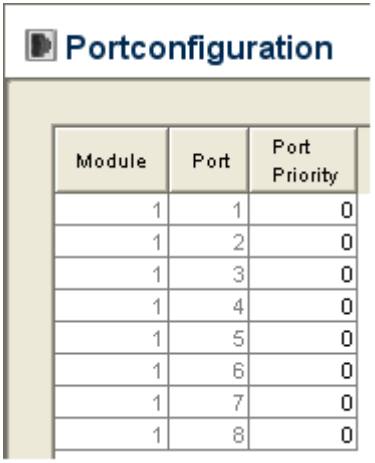
For receivied IP packets, the switch also performs VLAN priority remarking. In VLAN priority remarking, the switch modifies the VLAN priority of the IP packets if the packets are to be sent with a VLAN tag (ref Setting up the VLAN). Based on the traffic class to which the IP packet was assigned (see above), the switch assigns the new VLAN priority to the IP packet in accordance with the table below.

For example: a received IP packet with a DSCP value of 32 (cs4) is assigned to traffic class 2 (default setting). The packet was received at a port with port priority 2. In accordance with the table below, the VLAN priority is set to 4.

Traffic Class	New VLAN priority when receiving port has an even port priority	New VLAN priority when receiving port has an odd port priority
0	0	1
1	2	3
2	4	5
3	6	7

Port Configuration

The Port Configuration dialog box (partial view shown below) allows you to configure the switch's ports. With it, you can assign a port priority to a port.



The columns in dialog box represent the following:

- Module-the module of the switch on which the port is located.
- Port-the port to which this entry applies.
- Port priority-here you enter the port priority.

Entering the Port Priority

To assign port priorities, do the following:

Step	Action
1	Connect the ESM to an Ethernet cable.
2	Open the Web-based interface.
3	Go to QoS/Priority → Port Configuration to bring up the Port Configuration dialog box.
4	Enter the priority number (0-7) in the Port Priority column for Port 1.
5	Repeat step 4 for each additional port on the ESM switch that data packets are sent from.

According to the priority entered, the switch assigns the data packets that it receives at each port to a traffic class as shown below:

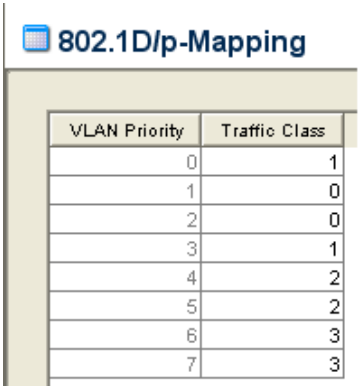
Port Priority	Traffic Class (default setting)	IEEE 802.1D Traffic Type
0	1	Best effort (default)
1	0	Background
2	0	Standard
3	1	Excellent effort (business critical)
4	2	Controlled load (streaming multimedia)
5	2	Video, less than 100ms of latency and jitter
6	3	Voice, less than 10ms of latency and jitter
7	3	Network control reserved traffic

Requirement:

- setting in the Global: Trust Mode dialog box: untrusted, or
- setting in the Global: Trust Mode dialog box: trustDot1p and the data packets do not contain a VLAN tag, or
- setting in the Global: Trust Mode dialog box: trustIpDscp and the data packets are not IP packets.

802.1D/p Mapping

The 802.1D/p Mapping dialog box allows you to assign a traffic class to every VLAN priority.



VLAN Priority	Traffic Class
0	1
1	0
2	0
3	1
4	2
5	2
6	3
7	3

Entering the Traffic Class

To map traffic classes to VLAN priorities, do the following:

Step	Action
1	Connect the ESM to an Ethernet cable.
2	Open the Web-based interface.
3	Go to QoS/Priorty → 802.1D/p Mapping to bring up the 802.1D/p Mapping dialog box.
4	Enter the desired value from 0 to 3 in the **Traffic Class** for every VLAN priority.

The switch assigns a default traffic class to the VLAN Priorities as shown in the table below:

VLAN Priority	Traffic Class (default setting)	IEEE 802.1D Traffic Type
0	1	Best effort (default)
1	0	Background
2	0	Standard
3	1	Excellent effort (business critical)
4	2	Controlled load (streaming multimedia)
5	2	Video, less than 100ms of latency and jitter
6	3	Voice, less than 10ms of latency and jitter
7	3	Network control reserved traffic

Note: Network protocols and redundancy mechanisms use the highest traffic class 3. Therefore, you select other traffic classes for application data.

IP ToS/DiffServ

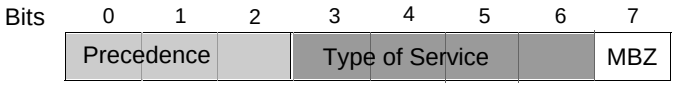
Overview

The Type of Service (ToS) field in the IP header has been part of the IP protocol from the start, and it is used to differentiate various services in IP networks. Back then, there were various ideas about differentiated treatment of IP packets, due to the limited bandwidth available along with the problem of unreliable connection paths. With the continuous increase in available bandwidth, there was no need to use the ToS field. Only with the real-time requirements of today's networks has the ToS field become significant again.

ToS Byte

Selecting the ToS byte of the IP header enables you to differentiate between different services.

The ToS byte is shown below:



The bit arrangement of the ToS field in the IP header is as follows:

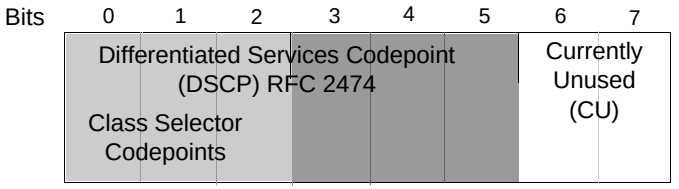
Bits 0-2	IP Precedence Defined	Bits 3-6	Type of Service Defined
111	Network Control	0000	all normal
110	Internetwork Control	1000	minimize delay
101	CRITIC/ECP	0100	maximize throughput
100	Flash Override	0010	maximize reliability
011	Flash	0001	minimize monetary cost
010	Immediate		
001	Priority		
000	Routine		
Bit 7 must be set to 0 (zero)			

Differentiated Services

The newly defined Differentiated Services field in the IP header in FRC2474, often known as the DiffServ Code Point or DSCP, replaces the ToS field and is used to mark the individual packets with a DSCP. As such, the packets are divided into different quality classes.

The first three bits of the DSCP are used to divide the packets into classes. The next three bits are used to further divide the classes on the basis of different criteria. In contrast to the ToS byte, DiffServ uses six bits for the division of up to 64 different service classes.

The differentiated Services field in the IP header is shown below.



The Per-Hop Behavior Classes

The different DSCP values get the device to employ a different forwarding behavior, called the Per-Hop Behavior (PHB). The PHB classes include:

- Class Selector (CS0-CS7): for reasons of Compatiblity to ToS Precedence.
- Expedited Forwarding (EF): premium service. Reduced delay, jitter + packet loss (RFC 2598).
- Assured Forwarding (AF): provides a differentiated schema for handling different data traffic (RFC 2597).
- Default Forwarding/Best Effort: no particular prioritizing.

The PHB class selector assigns the seven possible IP precedence values from the old ToS field to specific DSCP values, thus ensuring the downwards compatibility.

This arrangement is shown in the following table:

ToS Meaning	Precedence Value	Assigned DSCP
Network Control	111	CS7 (111000)
Internetwork Control	110	CS6 (110000
Critical	101	CS5 (101000
Flash Override	100	CS4 (100000
Flash	011	CS3 (011000
Immediate	010	CS2 (010000
Priority	001	CS1 (001000
Routine	000	CS0 (000000

The table below shows the mapping of the DSCP values onto the traffic classes.

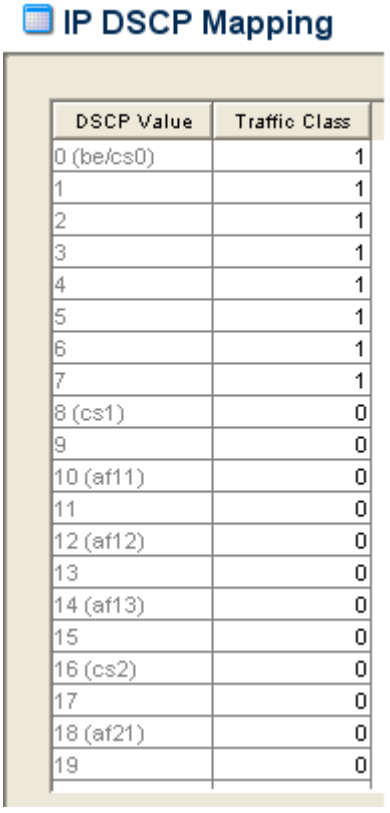
DSCP Value	DSCP Name	Traffic Class (default setting)
0	Best Effort/CS0	1
1-7		1
8	CS1	0
9,11, 13, 15		0
10, 12, 14	AF11, AF12, AF13	0
16	CS2	0
17, 19, 21, 23		0
18, 20, 22	AF21, AF22, AF23	0
24	CS3	1
25, 27, 29, 31		1
26, 28, 30	AF31, AF32, AF33	1
32	CS4	2
33, 35, 37, 39		2
34, 36, 38	AF41, AF42, AF43	2

DSCP Value	DSCP Name	Traffic Class (default setting)
40	CS5	2
41, 42, 43, 44, 45, 47		2
46	EF	2
48	CS6	3
49-55		3
56	CS7	3
57-63		3

IP DSCP Mapping

Introduction

The IP DSCP Mapping dialog box (partial view shown below) allows you to assign a traffic class to every DSCP value.



IP DSCP Mapping

DSCP Value	Traffic Class
0 (be/cs0)	1
1	1
2	1
3	1
4	1
5	1
6	1
7	1
8 (cs1)	0
9	0
10 (af11)	0
11	0
12 (af12)	0
13	0
14 (af13)	0
15	0
16 (cs2)	0
17	0
18 (af21)	0
19	0

Entering the Traffic Class

To map traffic classes for DSCP values, do the following:

Step	Action
1	Connect the ESM to an Ethernet cable.
2	Open the Web-based interface.
3	Go to QoS/Priority → IP DSCP Mapping to bring up the IP DSCP Mapping dialog box.
4	Enter the desired value from 0 to 3 in the Traffic Class for every DSCP value (0-63).

The different DSCP values get the switch to employ a different forwarding behavior, the Per-Hop Behavior (PHB).

The PHB classes include:

- Class Selector (CS0 to CS7): For reasons of compatibility to TOS/IP precedence
- Expedited Forwarding (EF): Premium service. Reduced delay, jitter + packet loss (RFC 2598).
- Assured Forwarding (AF): Provides a differentiated schema for handling dirfferent data traffic (RFC 2597)
- Default Forwarding/Best Effort: No particular prioritizing

The following table illustrates the mapping of the DSCP values onto the traffic classes.

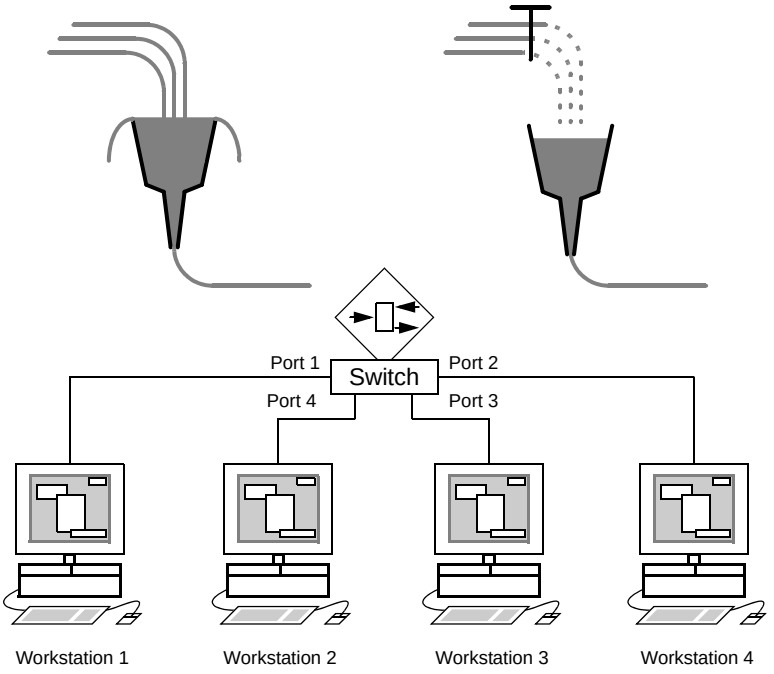
DSCP Value	DSCP Name	Traffic Class (default setting)
0	**Best Effort/CS0**	**1**
1-7		**1**
8	**CS1**	**0**
9,11,13,15		**0**
10,12,14	**AF11, AF12, AF13**	**0**
16	**CS2**	**0**
17,19,21,23		**0**
18,20,22	**AF21, AF22, AF23**	**0**
24	**CS3**	**1**
25,27,29,31		**1**
26,28,30	**AF31, AF32, AF33**	**1**
32	**CS4**	**2**
33, 35, 37, 39		**2**
34, 36, 38	**AF41, AF42, AF 43**	**2**
40	**CS5**	**2**
41,42,43,44,45, 47		**2**
46	**EF**	**2**
48	**CS6**	**3**
49-55		**3**
56	**CS7**	**3**
57-63		3

Flow Control

Description of Flow Control

Flow control is a mechanism which acts as an overload protection. During periods of heavy traffic it holds off additional traffic.

In the example below, the functioning of flow control is displayed graphically. Workstations 1, 2 and 3 want to simultaneously transmit a large amount of data to workstation 4. The combined bandwidth of Workstations 1, 2 and 3 is larger than the bandwidth of workstation 4 to the switch. This leads to an overflow of the send queue of port 4. The left-hand funnel symbolizes this status.



If the flow control function at ports 1, 2 and 3 of the switch is turned on, the switch reacts before the funnel overflows. Ports 1, 2 and 3 send a message to the connected devices that no data may be received at present.

Full Duplex Link

In the above example there is a full duplex link between workstation 2 and the switch. Before the send queue of Port 4 overflows, the switch sends a request to workstation 2 to include a small break in the sending transmission.

Half Duplex Link

In the above example there is a half duplex link between workstation 2 and the switch. Before the send queue of port 4 overflows, the switch sends data so that workstation 2 detects a collision and thus interrupts the transmission.

Setting Flow Control in the Web-Based Interface

You can set flow control as follows in the web-based interface.

Step	Action
1	Connect the ESM to an Ethernet cable.
2	Open the Web-based interface.
3	Go to Basics → Port Configuration.
4	Enable flow control for a particular port by checking Flow Control for the appropriate port number.
5	Go to Switching → Global. This dialog enables you to ● switch off flow control at all ports, or ● switch on flow control at all ports which have been selected for flow control in the configuration table.

VLANs

Description of VLANs

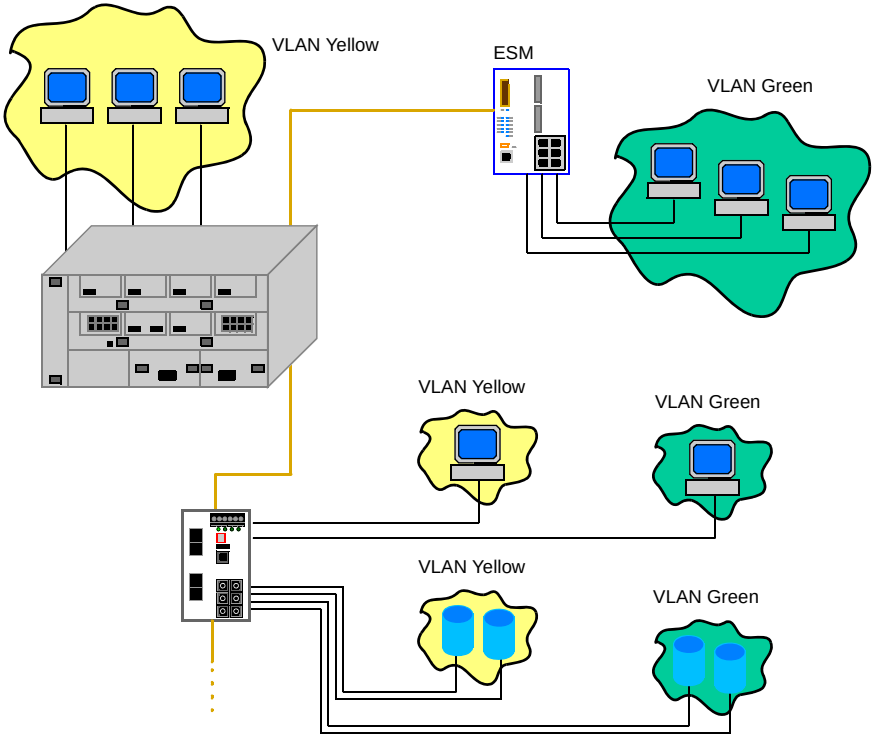
A virtual LAN (VLAN) consists of a group of network subscribers in one or more network segments which can communicate with each other as if they belonged to the same LAN.

VLANs are based on logical (instead of physical) links and are flexible elements in the network design. The biggest advantage of VLANs is the fact that they permit the formation of user groups based on their subscriber function and not on their physical location or medium.

Since broadcast/multicast data packets are transmitted exclusively within a virtual LAN, the remaining data is not affected.

The VLAN function is defined in the IEEEE 802.1Q standard. The maximum number of VLANs is limited by the structure of the VLAN tag to 4094 (*p. 113*).

The following figure shows a VLAN application example.



VLAN Keywords

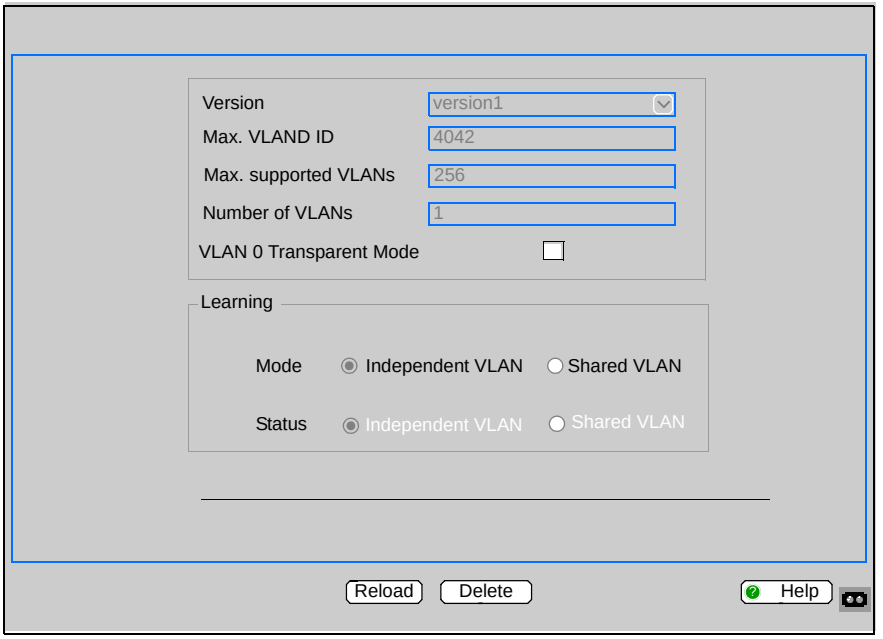
- Ingress Rule
  Ingress rules stipulate how incoming data are to be handled by the switch.
- Egress Rule
  Egress rules stipulate how outgoing data are to be handled by the switch.
- VLAN Identifier
  The assignment to a VLAN is executed using VLAN ID. Every VLAN in a network is identified with an ID which must be unique, i.e. every ID may only be assigned once in the network.
- Port VLAN Identifier (PVID)
  The management assigns a VLAN ID for every port. Thus, it is known as the port VLAN ID.
  The switch adds a tag to every packet received without a tag. This tag contains a valid VLAN ID.
  When a data packet is received with a priority tag, the switch adds the port VLAN ID.
- Member Set
  The member set is a list of ports belonging to a VLAN.
  Each VLAN has a member set.
- Untagged Set

The untagged set is a list of the ports of a VLAN which send data packets without a tag. Every VLAN has an untagged set.

Configuring VLANs

Configuration Procedure Using the Web-Based Interface

Configure VLANs as follows:

Step	Action
1	Connect the ESM to an Ethernet cable.
2	Open the Web-based interface.
3	Go the Switching → VLAN → Global. The VLAN Global dialog box opens:  In this dialog box you will find all tables and attributes to configure and monitor the VLAN functions complying with IEEE 802.1Q standard. **Note:** When configuring VLAN, the port to which your management station is connected must be able to send data of the management station after saving the VLAN configuration. If you assign the port to the VLAN with ID 1, the management station data will be sent. To set up VLANs, specify the desired VLANs in the desired VLAN Static table (*p. 136*). After setting up VLANs, specify the rules for received data in the VLAN Port table (*p. 139*).

Step	Action
4	Activate the VLAN 0 Transparent Mode in order to be able to send priority-tagged packets without VLAN membership, (that is, with VLAN ID 0). In this mode, the VLAN ID 0 remains in the packet, regardless of the setting of the port VLAN ID in the VLAN Port dialog box (*p. 139*). **Note:** In the transparent mode, the devices ignore the set port VLAN ID. Set the VLAN membership of the ports of VLAN 1 to member (M) or untagged (U) (*p. 137*).
5	Use the Delete button to restore all the default VLAN settings of the device (default settings).
6	Save the VLAN configuration so that it is effective after restart, then restart the switch.

Note: The 256 VLANs available can use any VLAN ID in the range of 1 to 4042.

Note: In the HIPER-Ring with VLANs, you should select only operate devices with the software that supports this function.

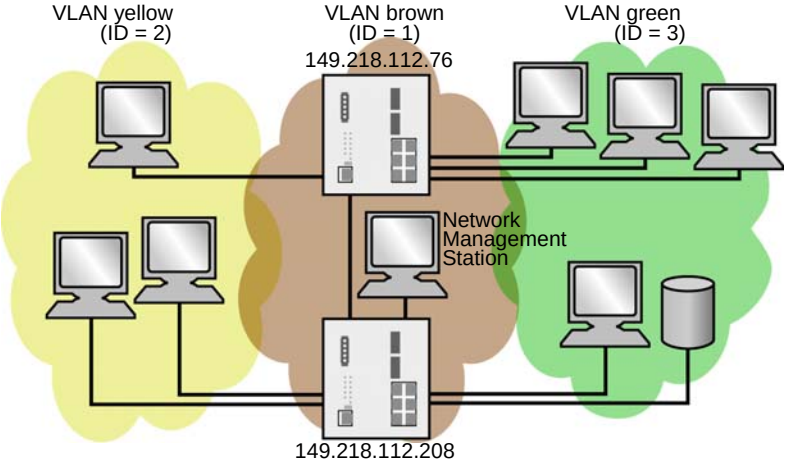
Note: In the HIPER-Ring configuration, select for the ring ports:
- VLAN ID 1 and Ingress Filtering are disabled in the port table (see *Specifying Rules for Data Received, p. 139*), and
- VLAN affiliation U in the static table (see *Defining the VLAN Membership of the Ports, p. 137*).

Note: In the Ring/Network coupling configuration, select for the coupling and partner coupling ports:
- VLAN ID 1 and Ingress Filtering disabled in the port table (*p. 139*), and
- VLAN affiliation U in the static table (*p. 137*).

Setting up VLANs

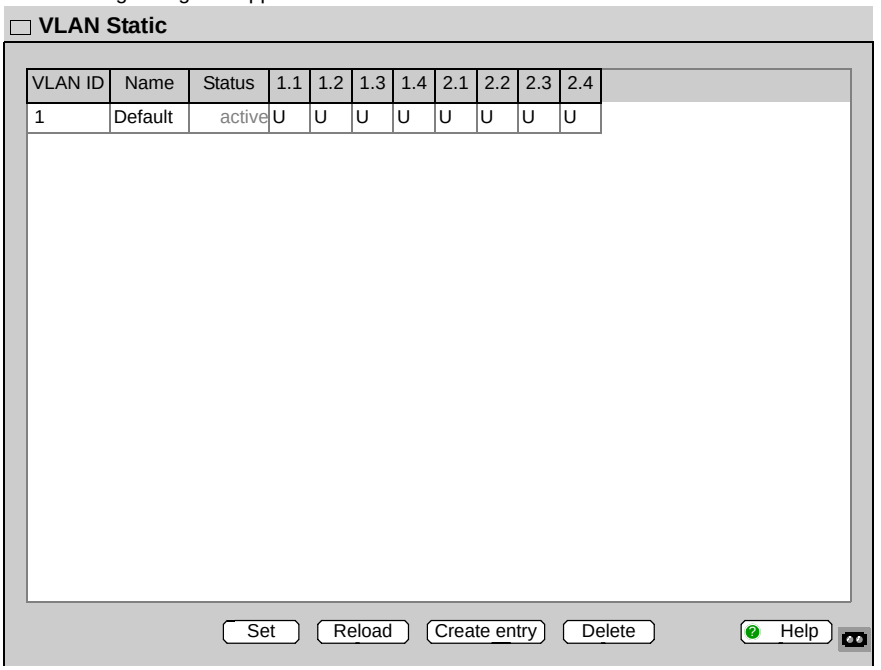
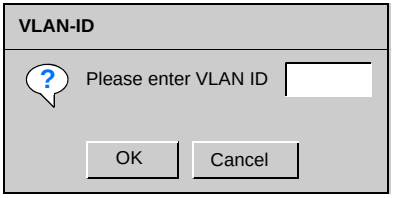
Simple VLAN Example

The following example reflects a standard implementation of ESM switches in a simple VLAN configuration shown below.



The yellow and green VLANs (IDs 2 and 3) contain terminal devices connected to ports on two EMS and a network management station that makeup the brown VLAN (ID 1).

Creating VLANs Set up VLANs as follows:

Step	Action
1	Connect the ESM to an Ethernet cable.
2	Open the Web-based interface.
3	Go to Switching | VLAN | Static. The following dialog box appears. 
4	Click Create entry. The VLAN-ID dialog box appears as shown below: 
5	Enter the appropriate VLAN ID (**2** for the example).
6	Click OK. A new VLAN entry appears in the VLAN Static dialog box
7	Repeat steps 4, 5 and 6 for VLAN 3.

Step	Action
8	Type in the names for each of the VLANs as shown below. **VLAN Static** VLAN ID | Name | Status | 1.1 | 1.2 | 1.3 | 1.4 | 2.1 | 2.2 | 2.3 | 2.4 1 | Brown | active | U | U | U | U | U | U | U | U 2 | Yellow | active | U | U | U | U | U | U | U | U 3 | Green | active | U | U | U | U | U | U | U | U Set Reload Create entry Delete Help
9	Click Set to apply the VLAN configuration.

Defining the VLAN Membership of the Ports

Next, you need to define the relationship of the ESM ports to the VLANs. You do this by using the VLAN static dialog box to assign membership roles to each of the ESM ports that are connected to the VLANs.

You can choose from the following options which are selectable from a drop-down list box that appears whenever you click on the ID column in the VLAN table.

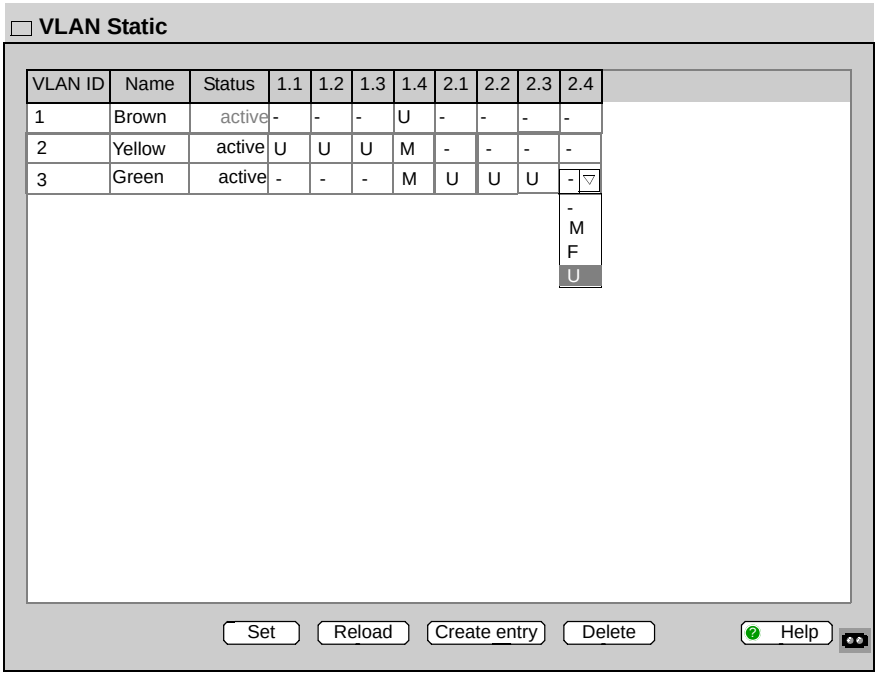
- -: not a member of the VLAN
- M: a member of the VLAN (packet is transmitted with a tag
- F: not a member of the VLAN
- U: a member of the VLAN (packet is sent without a tag)

With regards to our VLAN example, the port assignments will be made in accordance with the following assumptions:

- Ports 1.1 to 1.3 are assigned to the end devices of the yellow VLAN.
- Ports 2.1 to 2.4 are assigned to the end devices of the green VLAN.
- Since end devices normally do not sent data packets with a tag, the setting **U** must be selected for these ports.

- Port 1.4 serves as an uplink to the next switch in the brown VLAN, so it is assigned the **M** setting to allow VLAN information to be passed on.

The end result of configuring the VLAN membership of the ESM ports this way would appear as shown below:



You need to apply your settings by clicking Set.

Specifying Rules for Data Received

After setting up VLANs, you need to specify the rules for receiving data packets at each port by the ESM. There are three rules that apply as follows:

- Port VLAN ID:
  specifies to which VLAN a received untagged data packet is assigned to.
- Acceptable Frame Types:
  determines whether data packets can also be received untagged.
- Ingress Filtering:
  specifies whether the received tags are evaluated.

In order to apply these rules to the ports of the ESM switch you need to access the VLAN Port dialog box by selecting Switching | VLAN | Port.

As you can see, the last three columns of the table represent the rules discussed above. The Acceptable Frame Types column contains a drop-down list box that offers you a choice of admitAll or admitOnlyVlanTagged whenever you click on a column entry.

VLAN Port

Module	Port	Port VLAN ID	Acceptable Frame Types	Ingress Filtering
1	1	2	admitAll	☐
1	2	2	admitAll	☐
1	3	2	admitAll	☐
1	4	1	admitAll	☑
2	1	3	admitAll	☐
2	2	3	admitAll	☐
2	3	3	admitAll	☐
2	4	3	admitAll	☐

Set Reload Help

With regards to our VLAN example, the rules will be applied in accordance with the following assumptions:

Ports 1.1-1.3 and 2.1-2.4

- Ports 1.1 to 1.3 of the switch are assigned to the terminal devices of the yellow VLAN identified as VLAN ID 2.

- Ports 2.1 to 2.4 of the switch are assigned to the terminal devices of the green VLAN identified as VLAN ID 3.
- Since terminal devices normally do not send data packets with a tag, you select admitAll in the Acceptable Frame Types column for each one.

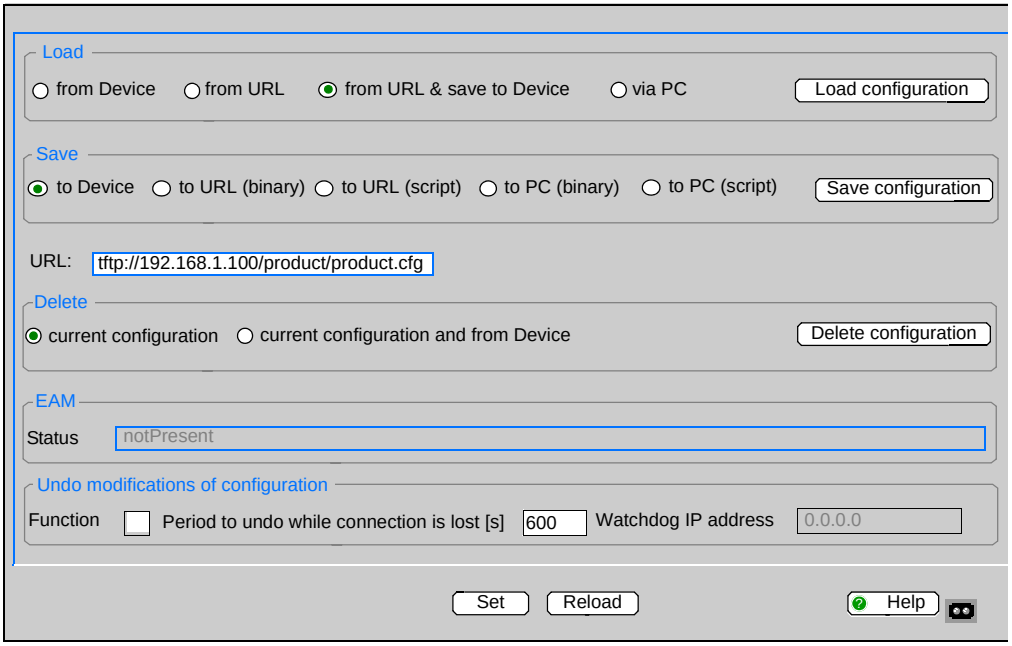
Port 1.4

- Port 1.4 functions as the uplink port to the next ESM switch. It belongs to the brown VLAN and is thus assigned VLAN ID 1. To ensure that only data packets with a VLAN tag can be received at this port, it is assigned the admitOnlyVlan-Tagged setting in the Acceptable Frame Types column.
- So that the tags received at this port are evaluated, check the Ingress Filtering checkbox.

The figure of the VLAN Port dialog box shown above represents the settings for the VLAN example discussed above. Save your settings by clicking Set.

Saving the VLAN Settings

Finally, you need to save the VLAN configuration to non-volatile memory. Proceed as follows:

Step	Action
1	Select **System** → **Load/Save** to display the Load/Save dialog box. 
2	In the Save panel, click on **to Switch**.
3	Click on **Save Configuration** to save the VLAN configuration to non-volatile memory.

Operation Diagnostics

9

Sending Traps

SNMP Traps

If unusual events occur during normal operation of the ESM, they are reported immediately to the management station. This is done by means of so-called trap alarms that bypass the polling procedure. (*Polling* means to query the data stations in regular intervals). Traps make it possible to react quickly to critical situations.

Examples for such events are:

- hardware reset
- changing the basic device configuration
- segmentation of a port

Traps can be sent to various hosts to increase the transmission reliability for the messages. A trap message consists of a packet that is not acknowledged.

The management agent sends traps to those hosts that are entered in the target table (trap destination table). The trap destination table can be configured with the management station via SNMP.

SNMP Trap Listing

All possible traps that can occur are listed in the following table.

Trap Description	A trap is sent if....
authenticationFailure	A station attempts to access an agent without permission.
coldStart	A cold and warm start occurs during the boot process after successful management initialization.
saMemoryBackupAdapterTrap	The Memory back up adapter is inserted or removed.
linkDown	The link to a port breaks.
linkUp	The link to a port is re-established.
saTemperature	This alarm message is sent if the temperature exceeds the limit set.
saPowerSupply	The status of the voltage supply changes.
saSignallingRelay	The status of the signal contact changes.

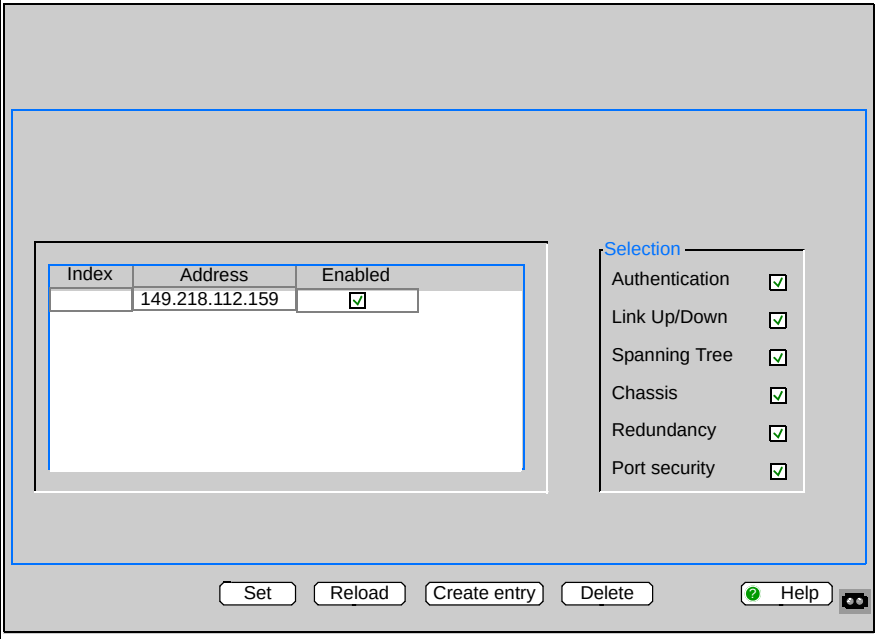
Trap Description	A trap is sent if....
newRoot	The sending agent becomes the new root of the spanning tree.
topologyChange	The transmission mode of a port changes.
risingAlarm	An RMON alarm input exceeds the upper threshold.
fallingAlarm	an RMON alarm input falls below the lower threshold.
saPortSecurityTrap	A MAC address is detected at the port which does not correspond to the current settings of: ● saPortSecPermission and ● saPorSecAction set either to trapOnly (2) or portDisable (3).
saModuleMapChange	The hardware configuration has changed.
saBDPUGuardTrap	A BPDU is received at a port although the BPDU guard function is activated.
hmMrpRecorfig	Is sent if the configuration of the MRP-Ring changes
saRingRedReconfig	when the configuration of the redundant ring changes.
saRingRedCplReconfig	The configuration of the redundant ring/network coupling changes.
saSNTPTrap	Status messages occur in connection with the SNTP protocol (e.g., server not available).
saRelayDuplicateTrap	A duplicate IP address is detected in connection with the DHCP Option.
IIdpRemTablesChangeTrap	This alarm message is sent if an entry in the topology table changes.

SNMP Traps when Booting

Note: The trap coldStart is sent during every boot procedure.

Configuring Traps Using the Web-Based Interface

Configure the traps as follows:

Step	Action
1	Connect the ESM to an Ethernet cable.
2	Open the Web-based interface.
3	Go to Diagnostics → Alarms (Traps). Access this dialog with the read-write password. The Alarms (Traps) dialog allows you to specify both the events triggering an alarm (trap) and the persons these alarms should be sent to. This figure shows the Alarms (Traps) dialog box. 
4	In the IP Address column, enter the IP address of a network management station which the traps should be sent to.
5	In the Enabled column, mark the entries which should be taken into account when traps are being sent.
6	In the Selection group box, check the trap categories from which you want to send traps.

Selecting Events Triggering an Alarm

You can have an alarm triggered in case of the following events by selecting them in the Selection group box of the Alarms (Traps) dialog box.

Event	Description
Authentication	The switch has rejected an unauthorized access attempt.
Cold Start	The switch has been turned on.
Link Up	The link to the device at one port of the switch has been established.
Link Down	The link to the device at one port of the switch has been interrupted.
Spanning Tree	The topology of the Rapid Spanning Tree has changed.
Chassis	Chassis encompasses the following events: ● Power Supply: The status of a supply voltage has changed as shown on the System dialog box. ● Signal Contact: The status of the signal contact has changed. To follow the event, go to Signal Contact, and select generate Trap. ● Media Module: A media module has been added or removed. ● Memory back up adapter: The Memory back up adapter has been inserted or removed. ● Temperature: The value has been exceeded/fallen below the temperature threshold.
Redundancy	The status of the HIPER-Ring or the redundant coupling of HIPER-Rings/ network segments has changed.
Port Security	A data packet has been received on one port from an unauthorized end device.

Contact Signal

Description of the Contact Signal

The signal contacts are for:

- controlling external devices by manually setting the signal contacts,
- monitoring proper functioning of the ESM which makes it possible to perform remote diagnostics.

By means of the potential-free signal contact (relay contact, closed circuit) a contact break is reported. This can be due to:

- inoperative power supply:
  the absence of the supply voltage 1/2,
  power supply voltage 1 or 2 < 18 V
  a continuous malfunction in the ESM (internal 3.3 VDC voltage),
- values that exceed or fall below the set temperature threshold,
- removing a module,
- removing the back up configuration adapter,
- the defective link status of at least one port
  With the ESM, the displaying of the link status can be masked by the management for each port (*p. 66*). The link status is not monitored in the default settings.
- HIPER ring event:
  the loss of redundancy guarantee (in redundancy manager mode). The Ring redundancy is not monitored in the default setting, Ignore.
- redundant ring network coupling event:
  the loss of redundancy guarantee. Redundant ring network coupling is not monitored in the default setting Ignore. In stand-by mode the ESM reports additionally the following conditions:
  - the missing link status of the control line,
  - partner device in stand-by mode.

The management setting determines which events causes a contact to the ESM.

Note: With non-redundant supply of the mains voltage, the ESM reports an absence of power. You can prevent this message by applying the supply voltage over the two inputs or by switching off the monitoring function.

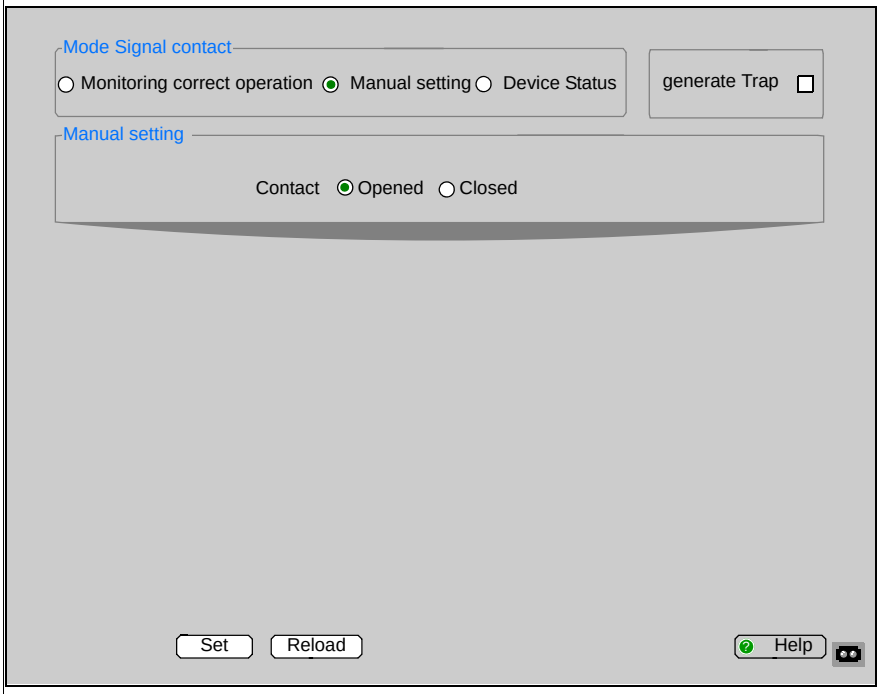
Manually Setting the Signal Contact

This mode enables you to carry out the remote switching of each signal individually. You have the following applications options:

- simulating an inoperative condition during PLC status monitoring,
- remote controlling a device using SNMP, for instance switching on a camera.

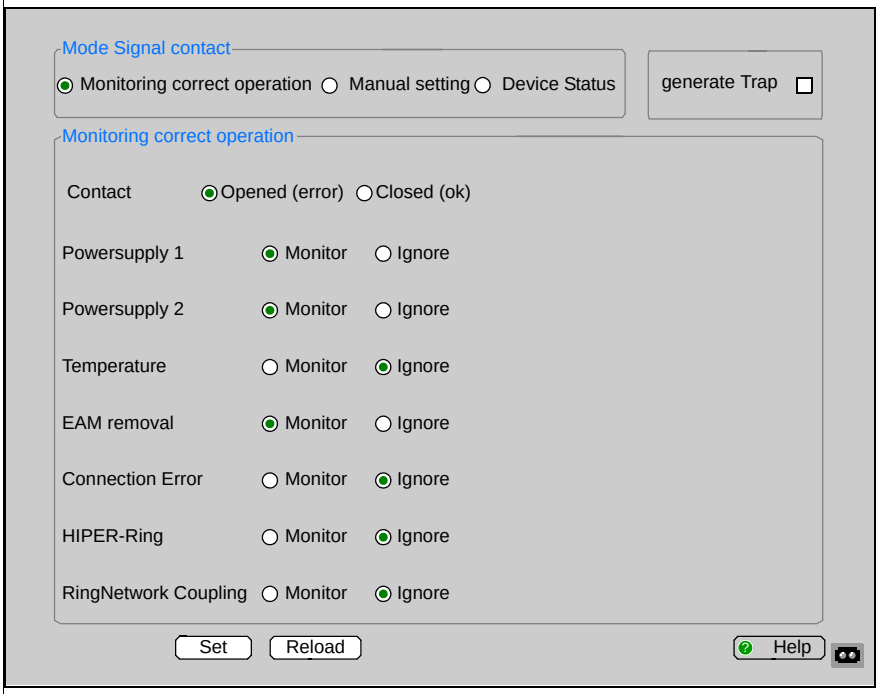
Setting Up Procedure Using the Web-Based Interface

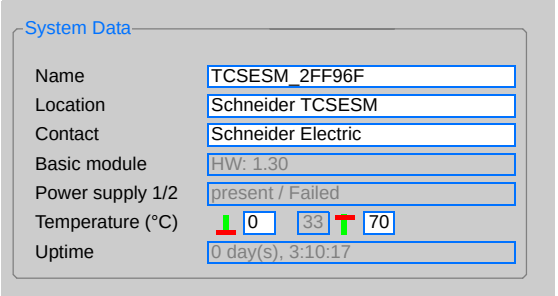
Set the signal contact as follows:

Step	Action
1	Connect the ESM to an Ethernet cable.
2	Open the Web-based interface.
3	Go to Diagnostics → Signal Contact.
4	Click Manual setting in the Mode Signal contact frame to set contact to manual. 
5	Click Opened in the Manual setting group box to open the contact.
6	Click Closed in the Manual setting group box to close the contact.

Configuring the Signal Contact for Monitoring Correct Operation in the Web-Based Interface

Configure the signal contact as follows:

Step	Action
1	Go to Diagnostics → Signal Contact.
2	Click Monitoring correct operation in the Mode Signal contact frame, to use the contact for function monitoring. 
3	In the Monitoring correct operation frame, select the events which you want to monitor by clicking on their associated Monitor option buttons.
4	For temperature monitoring, go to Basics → System in the main tree directory.

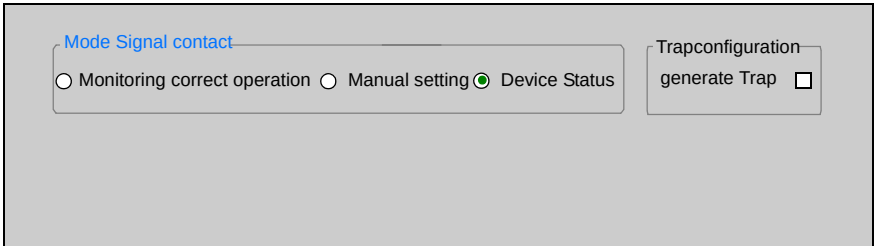
Step	Action
5	In the line Temperature (°C) of the System Data group box, set the temperature thresholds to be monitored. 
6	Deselect those events that you do not want to monitor by clicking on the appropriate Ignore option button.

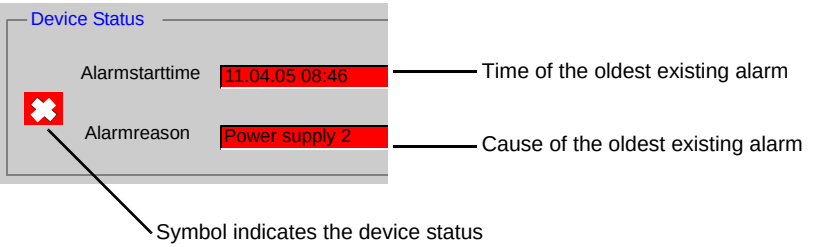
Displaying the Device Status

You can view the signal contact state in three ways:

- using the LED display
- using the Web-based interface
- executing a query in the command line interface

To view the signal contact status with the Web-based interface, proceed as follows:

Step	Action
1	Open the Web-based interface.
2	Go to Diagnostics → Signal Contact in the main tree directory to display the Signal Contact dialog box (partial view shown below). 
3	Click on the Device Status option button.
4	Go to Basics → System in the main tree directory.

Step	Action
5	Observe the Device Status frame in the upper left-hand corner of the ESM system display (shown below). 

Monitoring the Device Status of the ESM

Overview

The device status function provides a summary of the overall condition of the ESM. The ESM device status enables you to:

- Signal the device status out-of-band via a signal contact.
- Signal the device status by sending a trap when the device status changes.
- Detect the device status on the Web-based interface on the system side.
- Query the device status in the Command Line Interface.

What the Device Status Reports

The device status of the ESM includes:

- Incorrect supply voltage-the absence of at least one of the two supply voltages, or the device (internal supply voltage) becomes inoperative on a permanent basis.
- The temperature threshold has been exceeded or has not been reached.
- The removal of a module (for modular devices0:
- The removal of the EAM.
- The defective link status of at least one port. With the ESM, the indication of link status can be masked by the management for each port. On delivery, there is no link monitoring.
- HIPER-Ring event-the absence of the redundancy (in redundancy manager mode). On delivery, there is no ring redundancy monitoring.
- Ring/network coupling event-absence of the redundancy. On delivery, there is no ring redundancy monitoring.

The following conditions are also reported by the ESM device status in the standby mode:

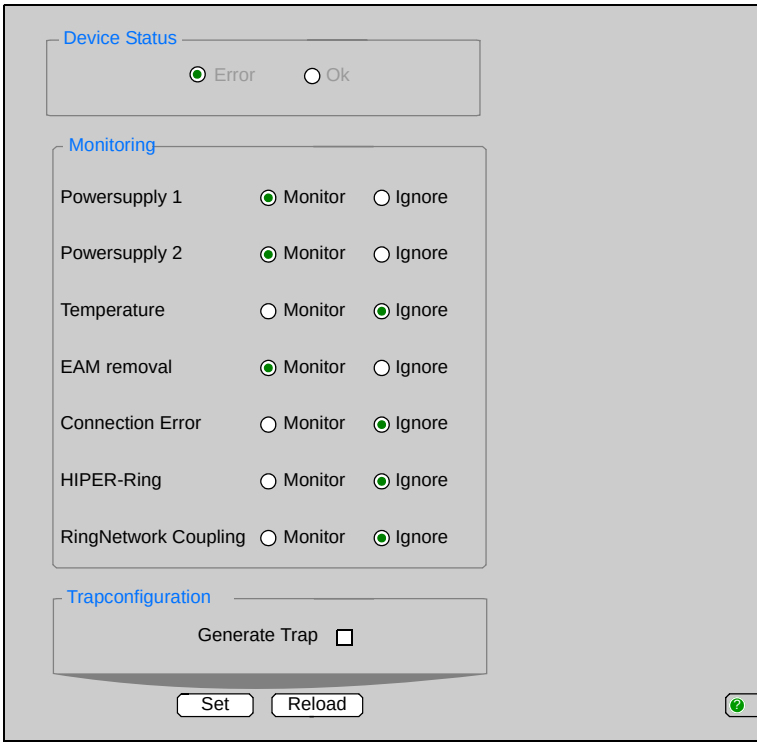
- Incorrect link status of the control line.
- Partner ESM is in the standby mode.

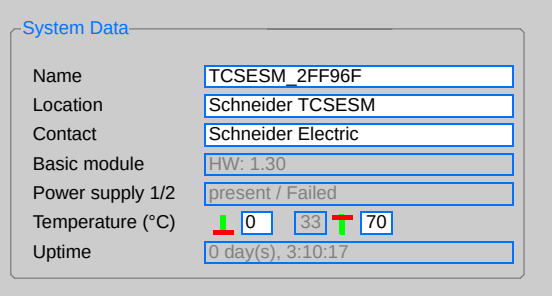
The management setting specifies which events determine the device status.

Note: With non-redundant voltage supply, the device reports the absence of a supply voltage. You can prevent this message by feeding the supply voltage over both inputs, or by switching off the monitoring.

Configuring the Device Status

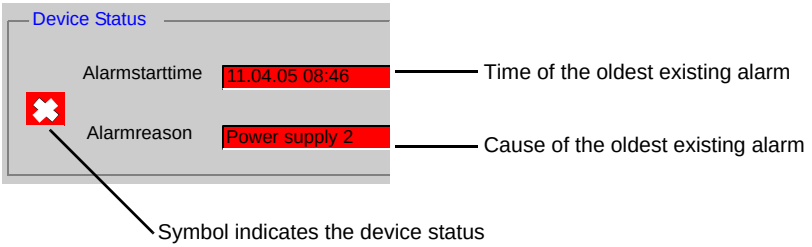
To setup the ESM device status, perform the following:

Step	Action
1	Connect the ESM to an Ethernet cable.
2	Open the Web-based interface.
3	Select Diagnostics → Device Status to display the Device Status dialog box. 
4	In the Monitoring frame, select the events you want to monitor by clicking on their associated Monitor option buttons.
5	For temperature monitoring, select the Temperature Monitor option button.
6	Go to Basics → System in the main tree directory

Step	Action
7	In the line Temperature (°C) of the System Data group box, set the temperature thresholds to be monitored. 
8	Deselect those events that you do not want to monitor by clicking on the appropriate Ignore option button.

Displaying the Device Status

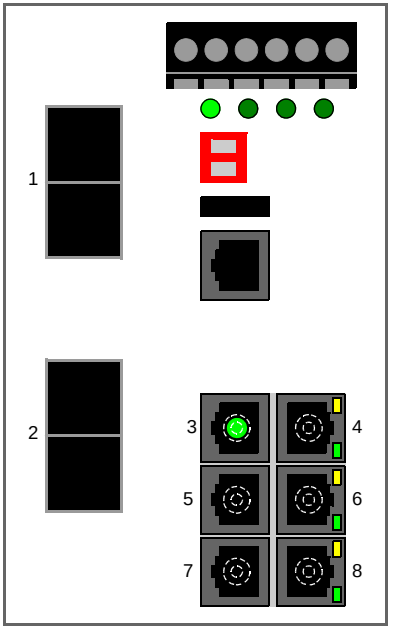
To determine the time and cause of the oldest existing ESM alarm, go toBasics → Systemin the main tree directory and observe Device Status frame in the upper left-hand corner of the ESM system display.



Displaying the Port Status

Using the Web-Based Interface

You can display the port status as follows:

Step	Action
1	Connect the ESM to an Ethernet cable.
2	Open the Web-Based interface.
3	Go to Basics → System. The figure below shows the device view. 
4	Point the mouse arrow at the symbols for the individual ports at the bottom of the screen. As a result, a box will appear which indicates the port status and other port-related information.

Event Counter on Port Level

The Port Statistics Table

The port statistics table allows experienced network administrators to identify possible problems occurring in the network.

This table shows you the contents of various events counters. After a restart, all the event counters begin at zero. The counters add up the events which have been transmitted and received.

The following table explains the content of various event counters.

Counter	Possible Problems
Received Fragments	• The controller of the connected device is faulty. • Electromagnetic interference is injected into transfer medium.
CRC Status	• The controller of the connected device is inoperative. • Electromagnetic interference is injected into the transfer medium. There is a faulty component in the network.
Collisions	• The controller of the device is inoperative. • The network expansion is too big or the line is too long. • A packet has collided with an interference signal.

Opening the Statistics Table Dialog in the Web-Based Interface

Open the statistics table as follows:

Step	Action
1	Connect the ESM to an Ethernet cable.
2	Open the Web-based interface.
3	Go to Diagnostics → Ports → Statistics. The Statistics table appears:

Module	Port	Transmitted Unicast Packets	Received Packets	Received Octets	Received Fragments	Detected CRC errors	Detected Collisions	Packets 64 bytes	Packets 65 to 127 bytes
1	1	0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0	0	0
3	3	0	0	0	0	0	0	0	0
3	3	0	0	0	0	0	0	0	0
3	3	0	0	0	0	0	0	0	0
3	3	0	0	0	0	0	0	0	0
4	4	0	0	0	0	0	0	0	0
4	4	0	0	0	0	0	0	0	0
4	4	0	0	0	0	0	0	0	0
4	4	0	0	0	0	0	0	0	0
5	5	676091	274384	274384	0	0	0	377820	214446
5	5	266919	2030742	1208661399	0	0	0	664755	385734
5	5	0	0	0	0	0	0	0	0
5	5	0	0	0	0	0	0	0	0

Reload Help

Resetting Port Counters Using the Web-Based Interface

Reset port counters as follows:

Step	Action
1	Go to Basics → Restart.
2	Click Reset port counters.

Displaying the SFP Status

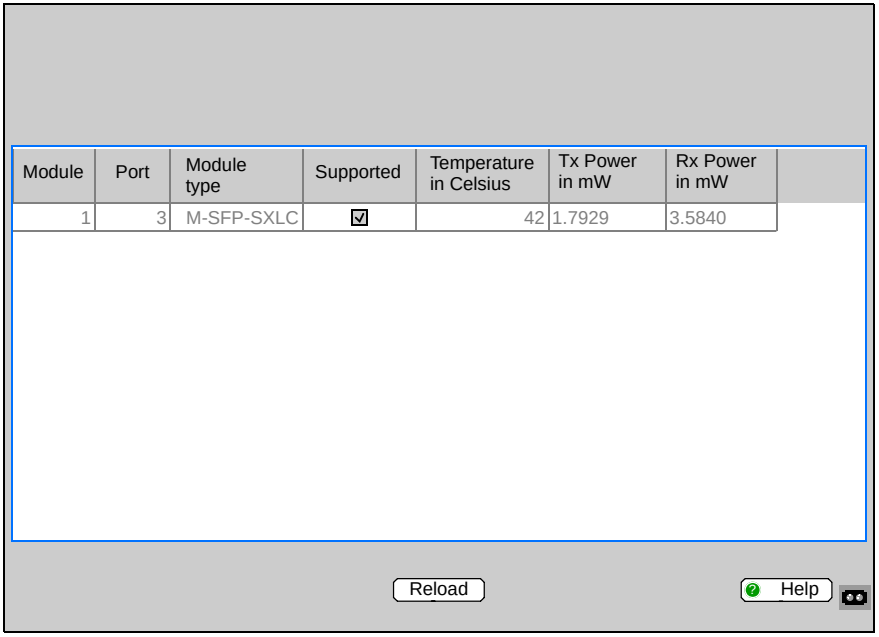
Properties of SFP Modules

By having the SFP status displayed, you can view the current connection to the SFP modules and their properties. The properties include:

- module type
- support provided in the media module
- temperature in degrees Celsius
- transmission power in mW
- reception power in mW

Opening the SFP Module Dialog Box in the Web-Based Interface

Open the SFP module dialog box as follows:

Step	Action
1	Connect the ESM to an Ethernet cable.
2	Open the Web-based interface.
3	Go to Diagnostics → Ports → SFP modules. The SFP module dialog box opens: 

Topology Discovery

Description of Topology Discovery

IEEE 802.1AB describes the Link Layer Discovery Protocol (LLDP).

LLDP allows users to automatically detect the topology of their LANs. A device with active LLDP

- sends its own connection and management information to neighboring devices of the shared LAN if they have LLDP activated,
- receives connection and management information from neighboring devices of the shared LAN if they have LLDP activated,
- and sets up a management information scheme and object definitions for saving connection information of neighboring devices that have LLDP activated.

The connection information contains as its most significant element the precise and unique ID of a connection endpoint: MSAP (MAC Service Access Point). This is composed of the MAC address of the device and a port ID that is unique to this device.

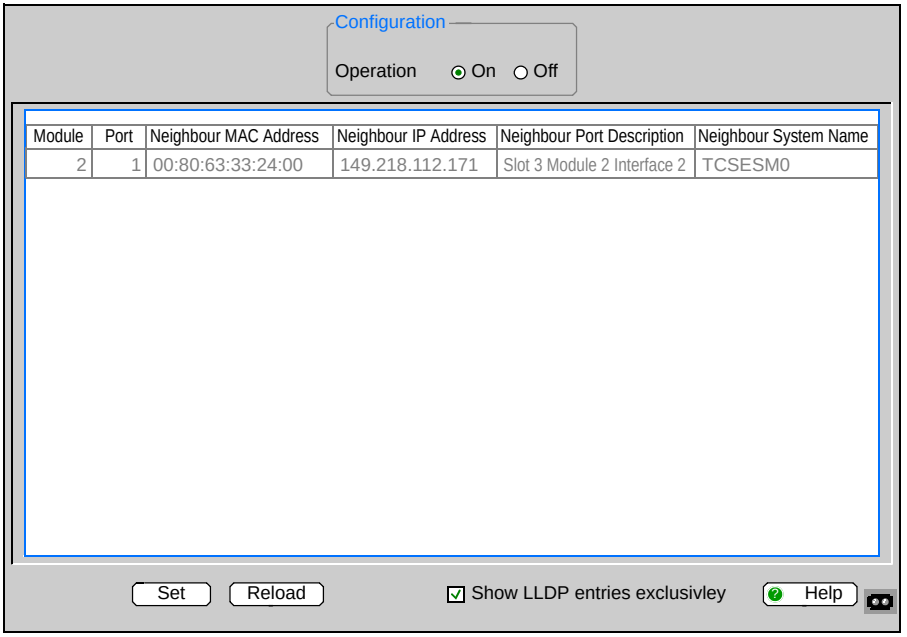
The contents of the connection and management information are:

- chassis ID (its MAC address)
- port ID (its port MAC address)
- description of the port
- system name
- system description
- currently activated *system capabilities*
- Interface ID of the management address
- VLAN-ID of the port
- status of autonegotiation on the port
- medium, half/full duplex setting and transmission speed setting of the port
- information about the redundancy protocol (STP, RSTP, HIPER ring, ring coupling, dual homing) activated at this port
- VLAN information concerning the port (VLAN ID and VLAN name)
  This information can be called up from a network management station. With this information, the network management station is able to display the topology of the network.
  LLDP uses an IEEE-MAC address for exchanging information. This address is normally not routed by switches. This is why switches without LLDP support drop the LLDP packets. Consequently, a non-LLDP-capable device between two LLDP-capable devices prevents the exchange of LLDP information.To avoid this, ESM Switch send additional LLDP packets to the ESM Multicast-MAC address 01:80:63:2F:FF:0B. ESM Switch with the LLDP function are thus also able to exchange LLDP information with each other via devices which themselves are not LLDP-capable.

The Management Information Base (MIB) of an LLDP capable ESM Switch holds out the LLDP information in the lldp-MIB and in the private salldp-MIB.

Displaying Topology Discovering the Web-Based Interface

Display topology discovery as follows:

Step	Action
1	Connect the ESM to an Ethernet cable.
2	Open the Web-based interface.
3	Go to Diagnostics → Topology Discovery. The table shows you the selected information to neighbor devices. 
4	Click Show LLDP entries exclusively to reduce the number of topology table entries. In this case, the topology table hides entries of devices without active topology discovery function.

Explanation concerning the Topology Discovery Dialog Box

If several devices are connected to a port, for example via a switch, the table shows one line for each connected device.

If

- devices with active topology discovery function and
- devices without active topology discovery function
  are connected to a port, the Topology Discovery table hides the devices without active topology discovery.

If

- only devices without active topology discovery are connected to a port, the table will contain one line for this port symbolically for all devices.
  MAC addresses of devices that the Topology Discovery table hides for the sake of clarity, are located in the Address table (*p. 95*).

Detecting IP Address Conflicts

Introduction

By definition, each IP address may only be assigned once within a subnetwork. If two or more devices erroneously share the same IP address within one subnetwork, this will inevitably lead to malfunctions, including communications disruptions with devices that have this IP address. A means must be provided to detect such a situation (referred to as IP address confliction) when it occurs on a subnetwork.

Address Conflict Detection

The ESM uses an Address Conflict Detection (ACD) mechanism to detect and eliminate IP address conflicts.

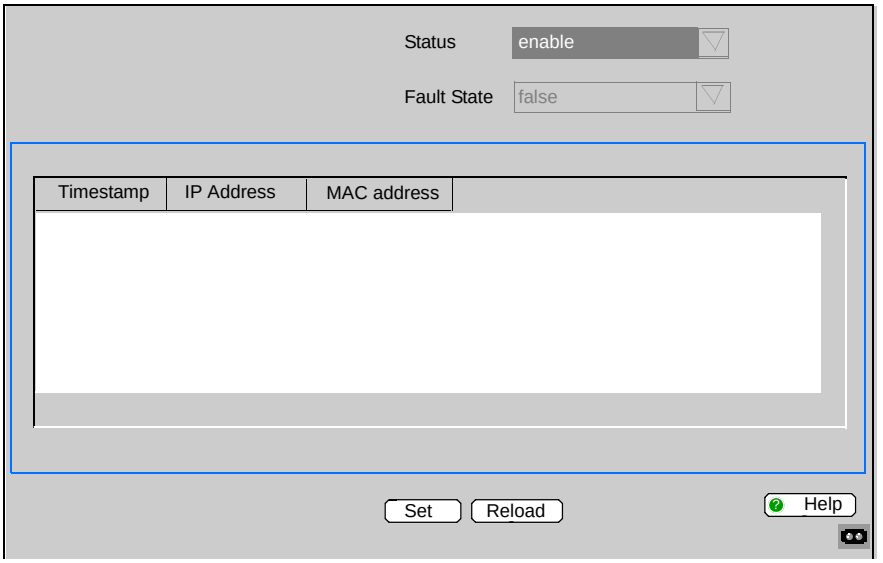
The ACD's -four modes of operation are described below:

Mode	Meaning
enable	Enables active and passive detection.
disable	Disables the function.
activeDectectionOnly	Enables active detection only. After connecting to a network or after an IP address has been configured, the ESM immediately checks whether its IP address already exists within the network. If it does, the switch will return to the previous configuration, if possible, and make another attempt after 15 seconds. Under no circumstances will the switch connect to the network with a duplicate IP address.
passiveOnly	Enables passive detection only. The ESM listens passively to the network to determine whether its IP address already exists. If it detects a duplicate IP address, it will initially defend its address by employing the ACD mechanism and sending out gratuitous ARP's. If the remote connection does not disconnect from the network, the management interface of the ESM will then disconnect from the network. Every 15 seconds thereafter, it will poll the network to determine if there is still an address conflict. If there isn't, it will connect back to the network.

Accessing ACD

In order to access the ACD mechanism on the ESM, perform the following steps:

Step	Action
1	Connect the ESM to an Ethernet cable.
2	Open the Web-based interface
3	Go to Diagnostics → IP Address Conflict Detection to display the dialog box.



The ESM logs each IP address conflict that occurs in the main table of the dialog box. For each conflict, the table lists:

- the time it occurs
- the conflicting IP address
- the MAC address of the device which the ESM conflicted with

For each IP address, the ESM logs a line with the above information for the last conflict that occurred.

You can delete the table by restarting the ESM.

Configuring ACD

To configure the ESM's ACD function, scroll to the desired mode in the Status field. The choices are identical to those listed in the table above.

Reports

Explanation of the Various Report Types

For diagnosis purposes, the ESM allows you to use the following reports:

- Log File:
  An HTML file in which the ESM records all important switch internal events.
- System Information:
  Information in an HTML file containing all system relevant data.
  These reports provide technicians with the information required for servicing the ESM.

Viewing and Sending the Reports Using the Web-Based Interface

Proceed as follows to view and open the reports:

Step	Action
1	Connect the ESM to an Ethernet cable.
2	Open the Web-based interface.
3	Go to Diagnostics → Reports. A window is opened which shows the following links: ● Log File ● System Information
4	Click Log File to open the HTML file in a new browser window.
5	Click System Information to open the HTML file in a new browser window.

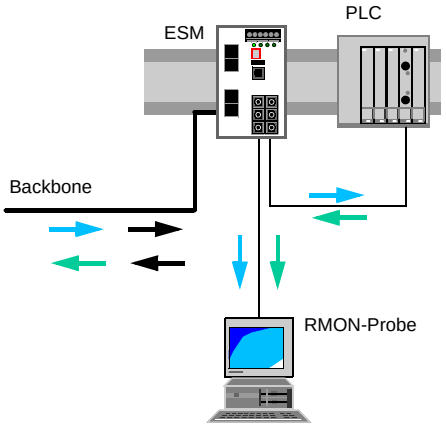
Monitoring Port Traffic

Port Mirorring

In port mirroring, data traffic related to one port (the source port) is copied to another (the destination port). Data traffic at the source port is not influenced by port mirroring. A management tool connected to the destination port, like an RMON probe, can observe data traffic at the source port.

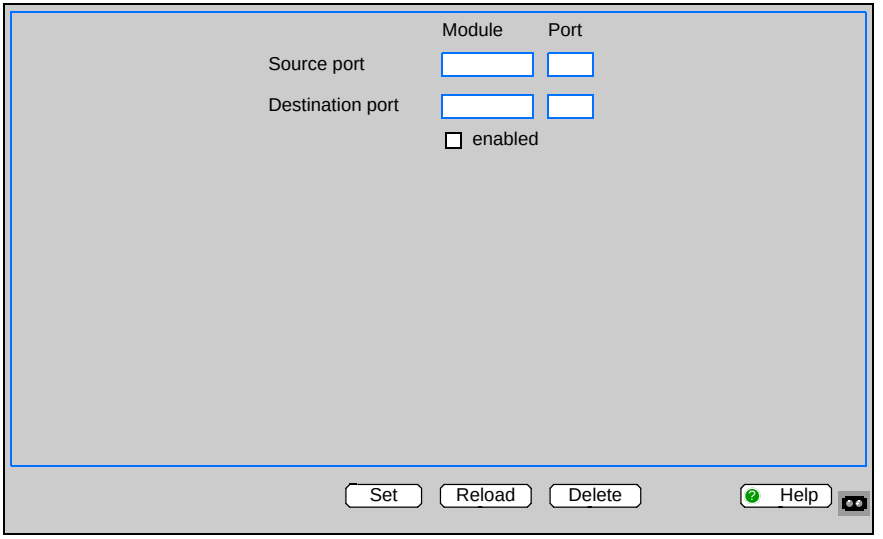
The destination port forwards data to be sent and blocks received data.

Port monitoring is shown in the figure below:



Monitoring Port Traffic

Monitor port traffic as follows:

Step	Action
1	Connect the ESM to an Ethernet cable.
2	Open the Web-based interface.
3	Go to Diagnostics → Port Mirroring. The following window below appears: 
4	Select the source port whose data traffic you wish to monitor.
5	Select the destination port to which you have connected your management tool.
6	Click enabled to enable the function.

EtherNet/IP

10

At a Glance

Overview

This chapter describes EtherNet/IP and its application to industrial network contol systems that utilize TCSESM managed Ethernet switches.

What's in this Chapter?

This chapter contains the following sections:

Section	Topic	Page
10.1	Introduction to EtherNet/IP and the TCSESM Switch	171
10.2	Configuring the TSCESM Switch as an EtherNet/IP Adapter in a Premium System	185
10.3	Configuring the TSCESM Switch as an EtherNet/IP Adapter in a Quantum System	204

10.1 Introduction to EtherNet/IP and the TCSESM Switch

At a Glance

Introduction

This section introduces the concept of the EtherNetI/IP protocol and its application to the TCSESM switch.

What's in this Section?

This section contains the following topics:

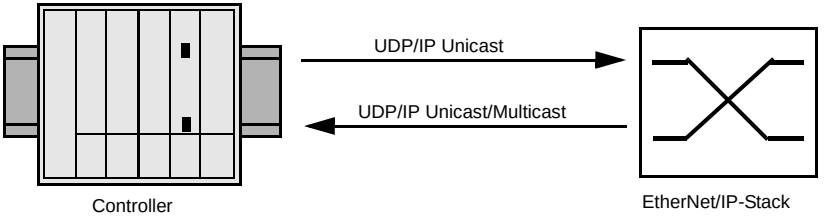
Topic	Page
What is EtherNet/IP	172
Verification of EtherNet/IP Protocol Settings	173
EtherNet/IP Parameters	175

What is EtherNet/IP

Introduction

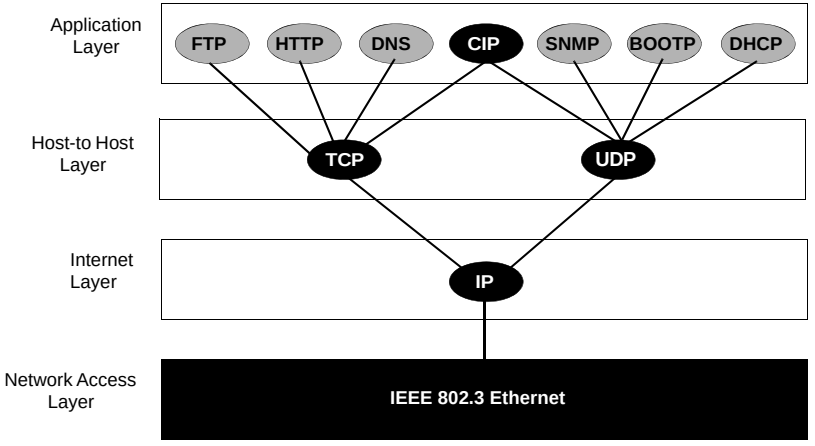
EtherNet/IP, which is accepted worldwide, is an industrial communication protocol standardized by ODVA (Open DeviceNet Vendor Association) on the basis of Ethernet. It is based on the widely used transport protocols TCP/IP and UDP/IP.

EtherNet/IP thus provides a wide basis, supported by leading manufacturers, for effective industrial data communication.



EtherNet/IP and CIP

EtherNet/IP adds the Common Industrial Protocol (CIP) to Ethernet as an application level for industrial automation applications



CIP is used for implicit, real-time I/O messaging and explicit information messaging that are not time critical.

Support for EtherNet/IP

Schneider Electric's ConneXium ESM Ethernet switches fully support the EtherNet/IP protocol.

Verification of EtherNet/IP Protocol Settings

Overview

Once the TCSESM Managed switch has been configured according to the procedures in the Configuration manual, you need to:

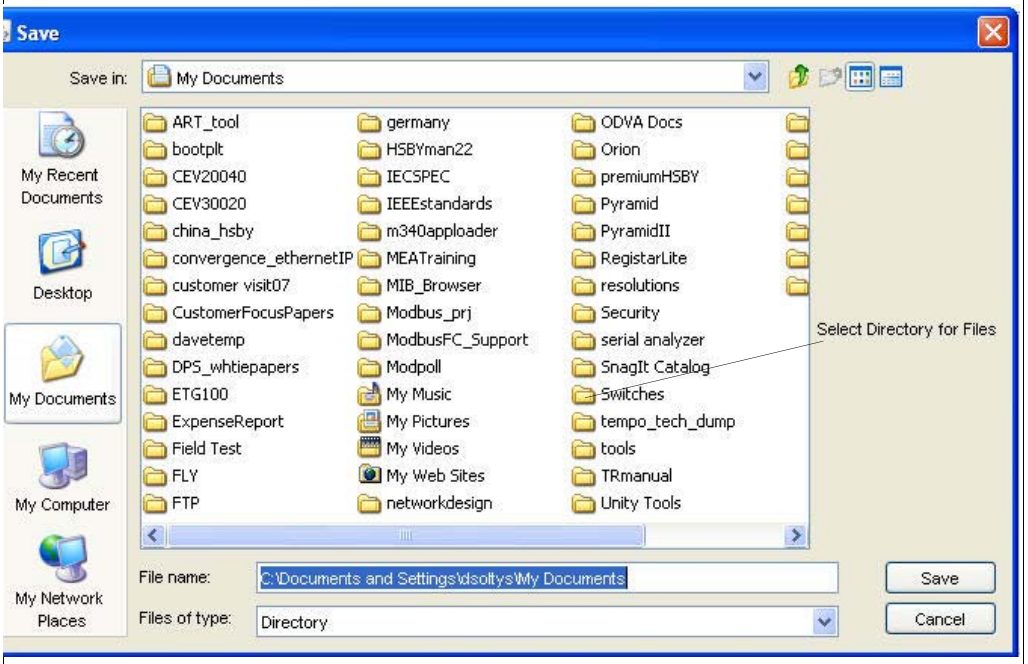
- verify that the EtherNet/IP has been activated
- download the EDS file to your PC
- check that IGMP Snooping is active

The steps for accomplishing this procedure are described below.

Activating EtherNet/IP

To activate the Ether Net/IP protocol and load the EDS file, perform the following steps.

Step	Action
1	In the tree view of the Web-based interface select Advanced → EtherNet/IP to bring up the EtherNet/IP dialog box. EtherNET/IP EtherNet/IP ☐ Download EDS File
2	Select the EtherNet/IP check box.
3	Click Set to activate the EtherNet/IP protocol.
4	Click Download EDS File to load the EDS file onto your PC.

Step	Action
5	Select the directory on the PC file where you want the EDS file and device icon to be saved. The File name field displays the path to the directory where the files will be saved. In the example shown, they will be saved to My Documents. 
6	Click Save. The downloaded EDS file will be saved to the directory you selected in step 5.

Deactivating IGMP Snooping

To activate the IGMP Snooping function, perform the following steps.

Step	Action
1	In the tree view of the Web-based interface select Switching → Multicasts to bring up the Multicasts dialog box (*p. 103*).
2	Click IGMP Snooping in the Global Configuration frame area.
3	Click Set to activate the IGMP Snooping function (*p. 101*).

EtherNet/IP Parameters

Introduction

This section describes the objects that makeup the EtherNet/IP parameters for the TCSESM Managed Switch.

Identity Object

The ESM switch supports the identity object (class code 01) of EtherNet/IP. The Schneider Electric manufacturer ID is 243. Schneider uses the manufacturer-specific ID 149 (95 hex) to designate the Managed Ethernet Switch product type.

Class Code

Hexadecimal	Decimal
16#01	1

Class Attributes

Attribute ID	Access	Name	Need	Data Type	Details
1	Get	Vendor ID		UNIT	Schneider
2	Get	Device Type		UNIT	Vendor Specific Definition
3	Get	Product Code		UNIT	Product Code: mapping is defined for every device type, e.g. xxxxxxxxxxxxxx
4	Get	Revision		STRUCT USINT Major USINT Minor	Revision of the EtherNet/IP implementation, currently 1.1, Major & Minor Revisions.
5	Get	Status		WORD	Not used
6	Get	Serial Number		UDINT	Serial number of the device (contains last 3 bytes of MAC address).
7	Get	Product Name		Short String (max. 32 byte)	Displays as "Schneider" + order code, e.g. Schneider xxxxxxxxxxxxxx.

TCP/IP Interface Object

The ESM switch supports an instance (instance 1) of the TCP/IP Interface Object (class code f5hex) of EtherNet/IP.

In the case of write access, the ESM switch stores the complete configuration in its flash memory. Saving can take 10 seconds. If the save process is interrupted, for example, by a power cut, the switch may crash.

Note: The switch replies to the configuration set request with a response before it finishes saving the configuration.

Class Code

Hexadecimal	Decimal
16#f5	245

Class Attributes

Attribute ID	Access	Name	Data Type	Details
1	Get	Status	DWORD	Interface Status (0 = Interface not configured, 1 = interface contains valid configuration.
2	Get	Interface Capability flags	DWORD	Bit 0 = BOOTP Client. Bit 1 = DNS Client. Bit 2 = DHCP Client. Bit 3 = DHCP-DNS Update. Bit 4 = Configuration settable (within CIP). Other bits reserved (0).
3	Set/Get	Config Control	DWORD	Bit 0-3: Value 0 = using stored config. Value 1 = using BOOTP. Value 2 = using DHCP. Bit 4 = 1 device uses DNS for name lookup (always 0 because not supported). Other bits reserved (0).
4	Get	Physical Link Object	Structure:UINT Path size EPATH Path	Path to the Physical Link Object, always (20hex, F6hex, 24hex, 01hex) describing instance 1 of the Ethernet Link Object.

Attribute ID	Access	Name	Data Type	Details
5	Set/Get	Interface Configuration	Structure: UDINT IP address UDINT Netmask UDINT Gateway address UDINT Name server 1 UDINT Name server 1 STRING Domain name	P IP Stack Configuration (IP-Address, Netmask, Gateway, 2 Nameserver (DNS, not supported) and the domain name).
6	Set/Get	Host name	STRING	Host name (for DHCP DNS Update.

Ethernet Link Object

The ESM switch supports at least one instance (instance 1 is the instance of the CPU Ethernet Interface) of the Ethernet Link Object of EtherNet/IP.

Class Code

Hexadecimal	Decimal
16#f6	246

Class Attributes

Attribute ID	Access	Name	Data Type	Details
1	Get	Interface speed	UDINT	Used interface speed in MBits/s (10, 100, 1000,...) 0 is used when the speed has not been determined or is invalid because of inoperable status conditions.
2	Get	Interface flags	DWORD	Interface Status Flags: Bit 0 = Link State (1=Link). Bit 1 = Halfduplex (0)/Full duplex (1). Bit 2-4 = Autoneg Status (0- Autoneg in progress, 1-Autoneg inoperative, 2-Autoneg inoperative but Speed detected, 3-Autoneg success, 4-No Augoneg). Bit 5 = manual configuration require reset (always 0 because not needed). Bit 6 = hardware inoperable status condition.
3	Get	Physical Address	ARRAY of 6 USINTs	MAC address of physical interface.
4	Get	Interface Counters	Struct MIB II Counters each UDINT	InOctets, InUcastPackets, InNUcastPackets, InDiscards, InErrors, InUnkownProtos, OutOctets, OutUcastPackets, OutNUcastpackets, OutDiscards, OutErrors.
5	Get	Media Counters	Struct Ethernet MIB Counters each UDINT	Alignment Errors, FCS Errors, Single collision, Multiple Collision, SQE Test Errors, Deferred Transmissions, Late Collisions, Excessive Collisions, MAC TX Errors, Carrier Sense Errors, Frame Too Long, MAC RX Errors.
6	Get/Set	Interface Counters	Struct Control Bits WORD Forced Iface Speed UINT	Control Bits: Autoneg enable/disable Bit 0, enable=1, Duplex mode (Bit1, full duplex=1), if Autoneg disabled (Bit 0 set to 0). Interface speed in MBits/s: 10, 100,..., if Autoneg disabled (Control Bit 0 set to 0).

Enhancements to the Ethernet Link Object-the ESM switch supports additional manufacturer-specific attributes described below.

Attribute ID	Access	Name	Data Type	Details
100 =64hex	Get	Ethernet Interface Index	UDINT	Interface/Port Index (ifIndex out of MIBII)
101 =65hex	Get/Set	Port Control	DWORD	Bit 0 (RO) Link state (0 link down, 1 link up) Bit 1 (R/W) Link admin state (0 disabled, 1 enabled) Bit 8 (RO) Access violation alarm Bit 9 (RO) Utilization alarm
102 =66hex	Get	Interface Utilization	UDINT	The existing Counter out of the private MIB hmlfaceUtilization is used. Utilization in percentage (Unit 1% = 100,%/100). RX Interface Utilization.)
103 =67hex	Get/Set	Interface Utilization Alarm Upper Threshold	UDINT	Within this parameter the variable hmlfaceUtilizationAlarmUpper-Threshold can be accessed. Utilization in percentage (Unit 1% = 100). RX Interface Utilization Upper Limit.
104 =68hex	Get/Set	Interface Utilization Alarm Lower Threshold	UDINT	Within this parameter the variable hmlfaceUtilizationAlarmLower-Threshold can be accessed. Utilization in percentage (Unit 1% = 100). RX Interface Utilization Lower Limit.
105 =69hex	Get/Set	Broadcast limit	UDINT	Broadcast limiter Service (Egress BC-Frames limitation, 0 = disabled), Frames/second.
106 =6Ahex	Get	Ethernet Interface Description	STRING (max. 64 Bytes) even number of Bytes	Interface/Port Description (from MIB II ifDescr), e.g. "Unit: 1 Slot: 2 Port: 1 - 10/100 MBit TX", or "unavailable", max. 64 Bytes.

Ethernet Switch Agent Object

The ESM switch supports the Schneider-specific Ethernet Switch Agent Object for the switch configuration and information parameters with one instance (instance 1)x

Class Code

Hexadecimal	Decimal
16#95	149

Class Attributes

Attribute ID	Name	Details
01	Switch Status	DWORD (32 bit) RO
Bit 0		Overall state (0=ok, 1=inoperative)like the signal contact.
Bit 1		Power Supply 1 (0=ok, 1=inoperative or not existing).
Bit 2		Power Supply 2 (0=ok, 1=inoperative or not existing).
Bit 3		Power Supply 3 (0=ok, or not possible on this platform 1=inoperative or not existing).
Bit 4		Power Supply 4 (0=ok, or not possible on this platform 1=inoperative or not existing).
Bit 5		Power Supply 5 (0=ok, or not possible on this platform 1=inoperative or not existing).
Bit 6		Power Supply 6 (0=ok, or not possible on this platform 1=inoperativeor not existing).
Bit 7		Power Supply 7 (0=ok, or not possible on this platform 1=inoperative or not existing).
Bit 8		Power Supply 8 (0=ok, or not possible on this platform 1=inoperative or not existing).
Bit 11		Signal Contact 1 (0=closed, 1=open).
Bit 12		Signal Contact 2 (0=closed, 1=open).
Bit 16		Temperature (0=ok, 1=inoperative).
Bit 17		Fan (0=ok or no fan, 1=inoperative).
Bit 24		Module removed (1=removed).
Bit 25		ACA removed (1=removed).
Bit 28		HIPER-Ring (1=inoperative).
Bit 29		Ring-/Netcoupling (1=inoperative).
Bit 30		Connection status condition(1=inoperative).
02	Switch Temperature	Struct(INT RO Temperature °FINT RO Temperature °C).
03	Reserved	Always 0, attribute is reserved for future use.

Attribute ID	Name	Details
04	Switch Max Ports	UINT (16 bit) RO Maximum number of Ethernet Switch Ports.
05	Multicast Settings (IGMP Snooping	UINT (16 bit) RW.
Bit 0	RW	IGMP Snooping (1=enabled, 0=disabled).
Bit 1	RW	IGMP Querier (1=enabled, 0=disabled).
Bit 2	RO	IGMP Querier Mode 1 (1=Querier, 0=Non-Querier).
Bit 4-6	RW	IGMP Querier Packet Version V1 =2, V2 = 2, V3 = 3 Off=0 (IGMP Querier disabled).
Bit 8-10	RW	Treatment of all Unknown Multicasts (Railswitch only): 0 = Send To All Ports, 1 = Send To Query Ports, 2 = Discard.
06	Switch Existing Ports	ARRAY OF DWORD (RS20) RW Bitmask Link Admin Status Switch Ports.
Per Bit starting with Bit 0 (=Port 1)		1=Port existing, 0=Port not available. Array (bit mask) size is adjusted at the size of maximum number of Switch ports (e.g. max. 28 Ports => 1 DWORD is used (32bit).
07	Switch Port Control	ARRAY OF DWORD RW Bitmask Link Admin Status Switch Ports.
Per Bit starting with Bit 0 (=Port 1)		0=Port enabled, 1=Port disabled. Array (bit mask) size is adjusted at the size of maximum number of Switch ports (e.g. max. 28 Ports => 1 DWORD is used (32bit).
08	Switch Port Mapping	ARRAY OF USINT (BYTE, 8 bit) RO Instance number of the Ethernet-Link-Object.
Starting with index 0 (=Port 1)		All Ethernet Link Object Instances for the existing Ethernet Switch Ports (1..N, maximum number of ports). When the entry is 0, the Ethernet Link Object for this port does not exist.
0x9	Switch Action Status	DWORD (32 bit) RO
Bit 0	RO	Flash write in progress.
Bit 1	RO	Flash write inoperative.

The Schneider specific Ethernet Switch Agent Object offers the addition vendor specific service with the service code 0 x 35 to save the switch configuration. The switch replies the save configuration request as soon as it has saved the configuration to the flash memory.

I/O Data

The precise meaning of the individual bits of the device state in the I/O data are described in the Ethernet Switch Agent Object (above).

I/O Data	Value (data types and size to be defined)	Direction
Device status	Bitmask (see Switch Agent Attribute 1)	Input, DWORD 32 bit
Link status	Bitmask, one Bit per port 0=NoLink, 1=Link	Input, DWORD
Output Links admin. state applied	Bitmask, (one Bit per port) to acknowledge output Link state change can be denied, e.g. for controller access port. 0=port enabled, 1=port disabled	Input, DWORD
Utilization alarm	Bitmask, one Bit per port 0=No alarm, 1=alarm on port	Input, DWORD
Access violation alarm	Bitmask, one Bit per port 0=No alarm, 1=alarm on port	Input, DWORD
Multicast Connections	Integer, number of connections	Input, DINT 32 bit
TCP/IP Connections	Integer, number of connections	Input, DINT 32 bit
Link admin. state	Bitmask, one Bit per port 0=port enabled, 1=port disabled	Output, DWORD

Mapping of the Ethernet Link Object Instances

The following table displays the mapping of the ESM switch port number to the Ethernet Link object Instance

Ethernet Link Object Instance	TCSESM Switch
1	CPU
2	1
3	2
4	3
5	4
6	5
7	6
8	7
9	8
10	9
11	10
12	11
13	12
14	13
...	...

Supported Services

The following table give an over view of the supported services by the EtherNet/IP implementation for the objects instance.

Service Code	Identity Object	TCP/IP Interface Object	Ethernet Link Object	Switch Agent Object
Get Attribute All (0x01)	All attributes	All attributes	All attributes	All attributes
Get Attribute All (0x02)	-	Settable attributes (3, 5, 6)	-	-
Get Attribute Single (0x0e)	All attributes	All attributes	All attributes	All attributes
Get Attribute All (0x10)	-	Settable attributes (3, 5, 6)	Settable attributes (6, 0x65, 0x68, 0x69)	Settable attributes (7)
Reset (0x05)	Parameter (0,1)	-	-	-
Save Configuration (0x35) Vendor specific	Parameter (0,1)	-	-	Save switch configuration

10.2 Configuring the TSCESM Switch as an EtherNet/IP Adapter in a Premium System

At a Glance

Introduction

The section describes the configuration of a TSCESM switch as an EtherNet/IP adapter in a Premium system using Unity Pro software.

What's in this Section?

This section contains the following topics:

Topic	Page
Overview of the TCSESM EtherNet/IP Premium Network Setup	186
Adding EDS Files	188
Automatically Detect and Add the TCSESM Switch	191
Configuring the TCSESM Switch Properties	193
Viewing the TCSESM Switch Data	196
SEND_REQ Example-Get_Attributes_Single	198

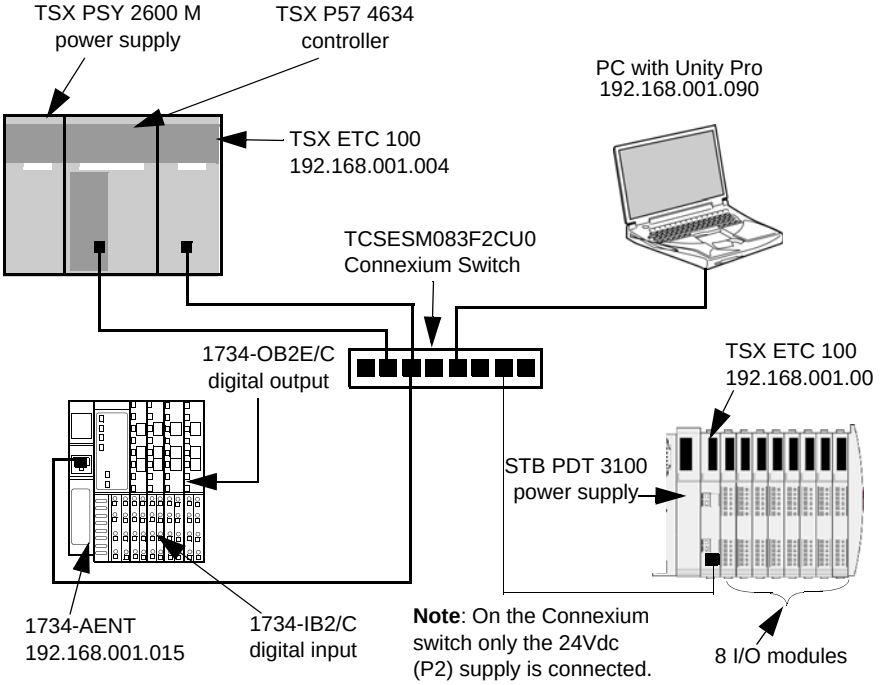
Overview of the TCSESM EtherNet/IP Premium Network Setup

Introduction

The addition of the EtherNet/IP function to Schneider's Connexium Managed Switch product line allows the ESM to be configured as an EtherNet/IP adapter in a Premium system using a TSX ETC 100 EtherNet/IP module. An example of such an arrangement is described below.

Network Topology

The required hardware and the connections involved to develop a network topology looks like this:



To re-create this example, be sure to:

- use the IP addresses for your own configuration's:
  - PC
  - TSX ETC 100 EtherNet/IP communication module
  - STB NIC 2212 EtherNet/IP network interface module
  - 1734-AENT PointIO adapter
- check all wiring

Note: Unity Pro software running in the PC is used to configure the TSX P57 4634 controller. In this example, the PC is indirectly wired to the CPU's Ethernet port via the Ethernet switch. Alternatively, you could bypass the switch and directly wire the PC to another one of the CPU's ports.

Adding EDS Files

Overview

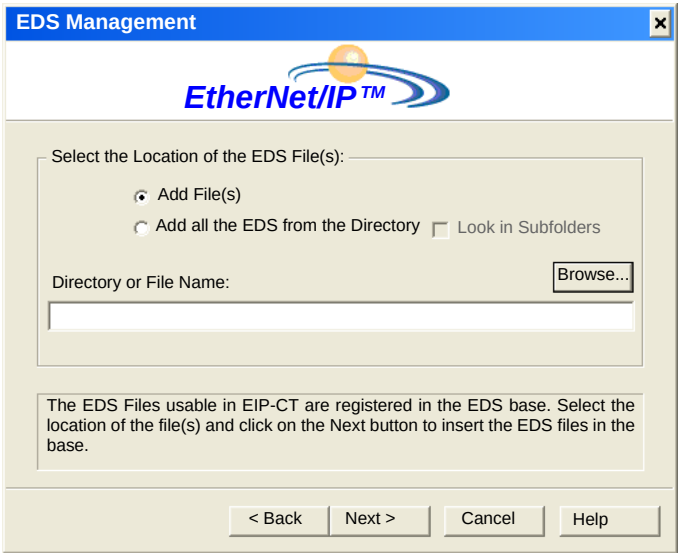
Before the TCSESM switch can be configured in a Premium system, the TCSESM EDS file has to be added to the Unity Pro EtherNet/IP configuration tool's Device Library.The tool includes an EDS Management wizard that you can use to add one or more EDS files to the Device Library. The wizard presents a series of instruction screens that:

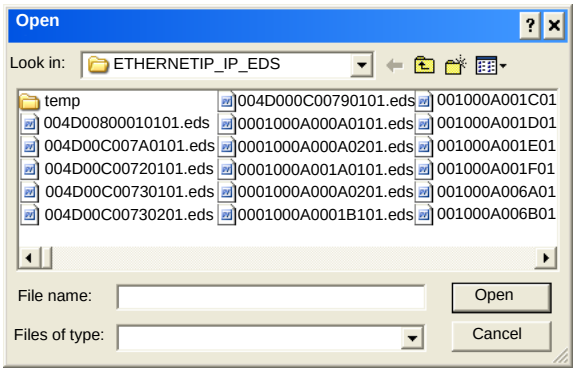
- simplify the process of adding EDS files to the Device Library, and
- provide a redundancy check in case you attempt to add duplicate EDS files to the Device Library

Note: During the following procedure, you can select Devices → Options... to open the Display Options window, where you can enable/disable messages indicating the EDS file you are adding is a duplicate—or a different version—of an existing EDS file.

Adding EDS Files

To add one or more EDS files to the Device Library:

Step	Action
1	Open the Unity project with ETC configured.
2	Open the ETC module properties.
3	Click on the EtherNet/IP button to open the EIP configuration tool.
4	Do one of the following: ● in the Device Library, click the Add button , or ● select Library → Add Page 1 of the wizard opens.
5	Click Next. Page 2 of the wizard opens: 
6	In the Select the Location of the EDS File(s) section, select either: ● Add File(s), to add one or more EDS files you will individually select, or ● Add all the EDS Files from the Directory, to add all files from a folder you will select. ● Select Look in Subfolders to add EDS files in subfolders beneath the folder you select

Step	Action
7	Click the Browse button. The Open dialog opens. The Open dialog opens: 
8	Use the Open dialog to navigate to and select: ● one or more EDS files, or ● a folder containing EDS files
9	After you have made your selection(s), click Open. The dialog closes and your selection appears in the Directory or File Name field.
10	Click Next. The wizard compares the selected EDS files against existing files in the Device Library.
11	(Conditional) If one or more selected EDS files are duplicates and if notice of redundant files is enabled in the Display Options dialog, a File Already Exists message displays. Close the message.
12	Page 3 of the wizard opens indicating the Status of each device you attempted to add: ● a green check mark indicates the EDS file can be added ● a blue informational icon indicates a redundant file ● a red check mark indicates an invalid EDS file (Optional) Select a file in the list, then click View Selected File to open it.
13	Click Next to add the nonduplicate files. Page 4 of the wizard opens, indicating the action is complete.
14	Click Finish to close the wizard. The device(s) you added can now be inserted into your EtherNet/IP configuration.

Automatically Detect and Add the TCSESM Switch

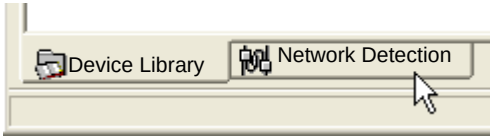
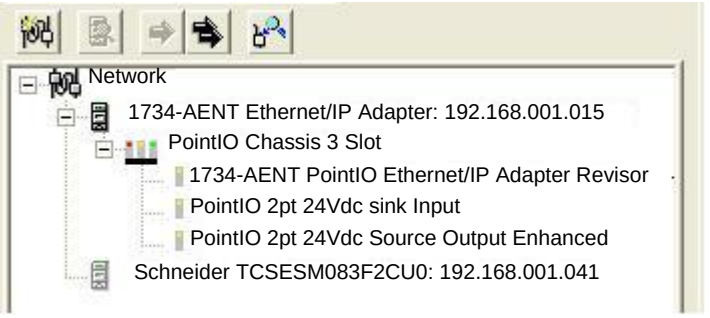
Overview

Use the Unity Pro EtherNet/IP configuration tool to automatically detect the TCSESM switch. After it is detected, you can add it to your project.

Note: The TCSESM must be active online with a valid IP address before you can detect and add it to your project.

Detecting and Adding Network Devices

To automatically detect the TCSESM and then add it to your project, follow these steps:

Step	Action
1	Launch the configuration tool from the Configuration page of the EtherNet/IP communication module's Properties window.
2	In the configuration tool, begin on-line operations by clicking the Go Online button .
3	Click the Configuration tab to enable automatic network detection: 
4	Click the Read Network Configuration toolbar button . The configuration tool searches the network for EtherNet/IP devices, classifies them using the device EDS file, then lists the EtherNet/IP devices it detects. 
5	Select the 1734-AENT PointIO Adapter in the Network Detection window.
6	Click the Insert in Configuration button to open the Properties window, where you can configure the 1734-AENT PointIO adapter.

Configuring the TCSESM Switch Properties

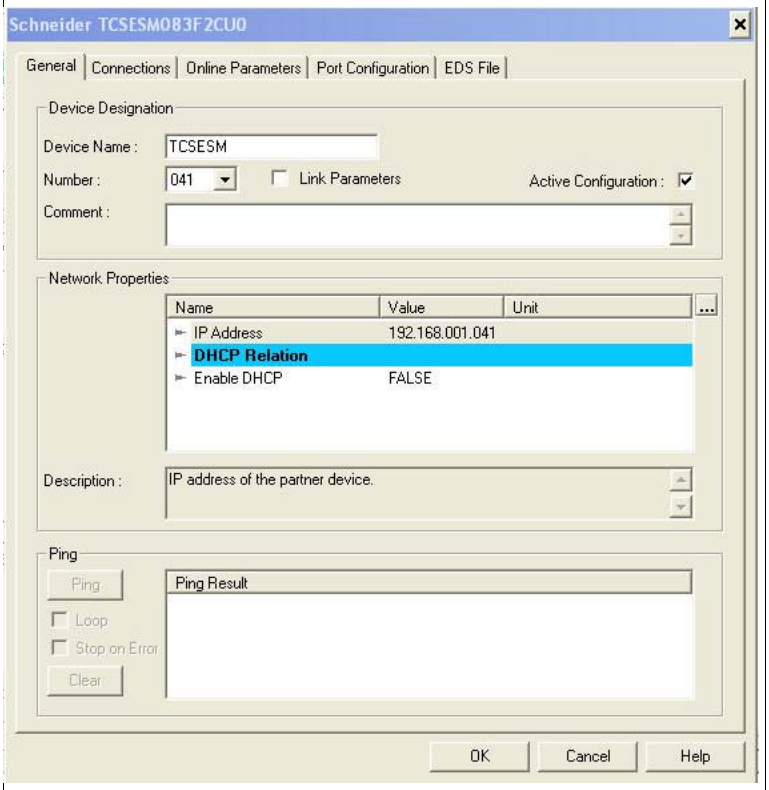
Overview

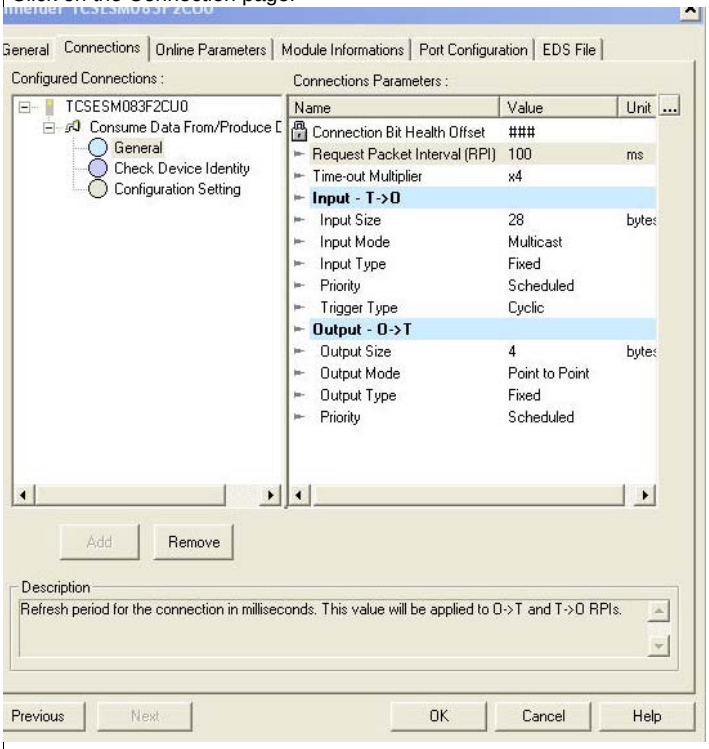
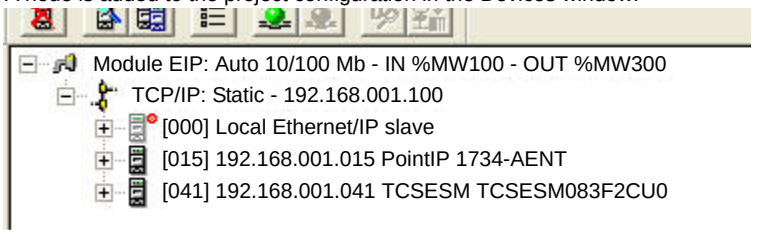
The TCSESM switch properties window presents the following tabbed pages. Only some of these pages need to be edited for this example:

In this page...	Do the following...
General	● input device name ● configure IP address ● add the device to the project configuration
Connections	Accept the default settings.
Online Parameters	Accept the default settings, if any.
Module Informations	(Read-only page—no configuration required)
Port Configuration	(Read-only page—no configuration required)
EDS File	(Read-only page—no configuration required)

Configuring the TCSESM

The following settings were used in the sample configuration:

Step	Action	
1	Click on the General page: 	
2	In the General page, edit the following settings:	
	Device Name	TCSESM
	Number	The sequence of the device in the Devices window. for this example, type in 041.
	Active Configuration	Be sure this checkbox is selected.
	IP Address	192.168.001.041

Step	Action
3	Click on the Connection page: 
4	Under Configured Connections, select General.
5	Under Connection Parameters, select Request Packet Interval (RPI).
6	Select the value and change it to 100.
7	Click OK to save your settings and close the properties window. A node is added to the project configuration in the Devices window:  The next step is to view the remote device's inputs and outputs.

Viewing the TCSESM Switch Data

Overview

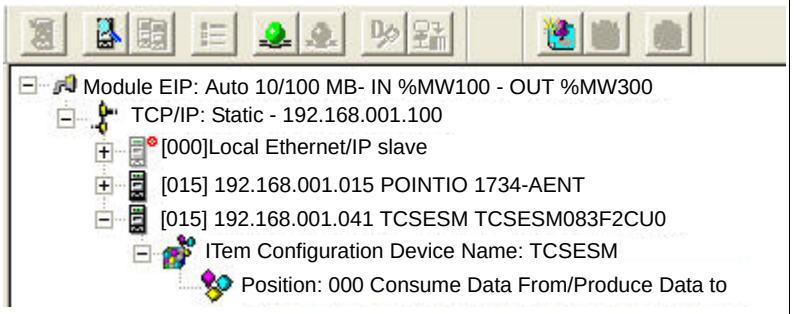
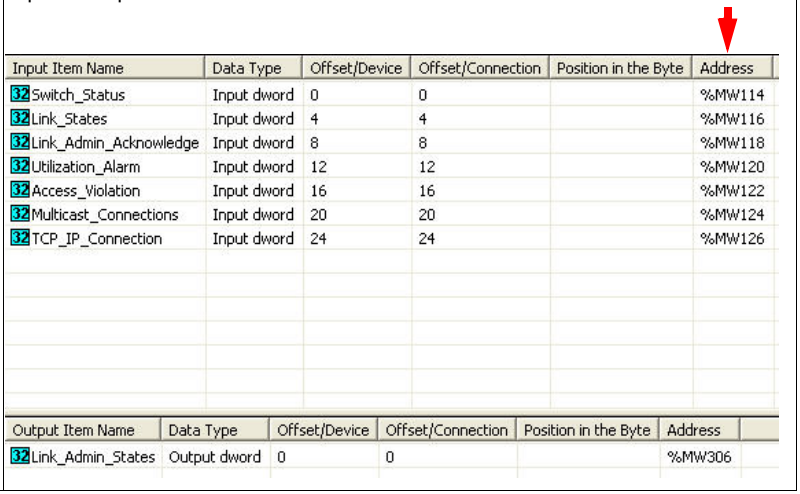
Because the Device Library includes EDS files for the TSCESM switch PointIO adapter and its discrete input and output modules, the Unity Pro EtherNet/IP configuration tool automatically:

- creates a single rack optimized CIP connection from the TCSESM's EtherNet/IP communication module to the 1734-AENT, and
- configures each input and output item by assigning:
  - an item name
  - an address location
  - a size allotment based on its data type

Note: In this example, the configuration tool created a single rack optimized connection, which is a more efficient use of CIP connections. A rack optimized connection can be used only with discrete (digital) I/O modules. For analog I/O modules, each analog module must be connected to the TCSESM using a separate connection.

Viewing the TCSESM Switch Data

To view the automatically created CIP connection and the I/O items in the Unity Pro EtherNet/IP configuration tool:

Step	Action
1	In the Protocol window, navigate to and select Position: 000 Consume Data From/ Produce Data to:  The automatically configured input and output items appear on the right side of the screen in the I/O area (shown below).
2	If necessary, use the horizontal scroll bar to scroll to the far right of the input or output area and display the Address column, which identifies the location of the input or output in the TSX ETC 100: 

Input Item Name	Data Type	Offset/Device	Offset/Connection	Position in the Byte	Address
Switch_Status	Input dword	0	0		%MW114
Link_States	Input dword	4	4		%MW116
Link_Admin_Acknowledge	Input dword	8	8		%MW118
Utilization_Alarm	Input dword	12	12		%MW120
Access_Violation	Input dword	16	16		%MW122
Multicast_Connections	Input dword	20	20		%MW124
TCP_IP_Connection	Input dword	24	24		%MW126

Output Item Name	Data Type	Offset/Device	Offset/Connection	Position in the Byte	Address
Link_Admin_States	Output dword	0	0		%MW306

SEND_REQ Example-Get_Attributes_Single

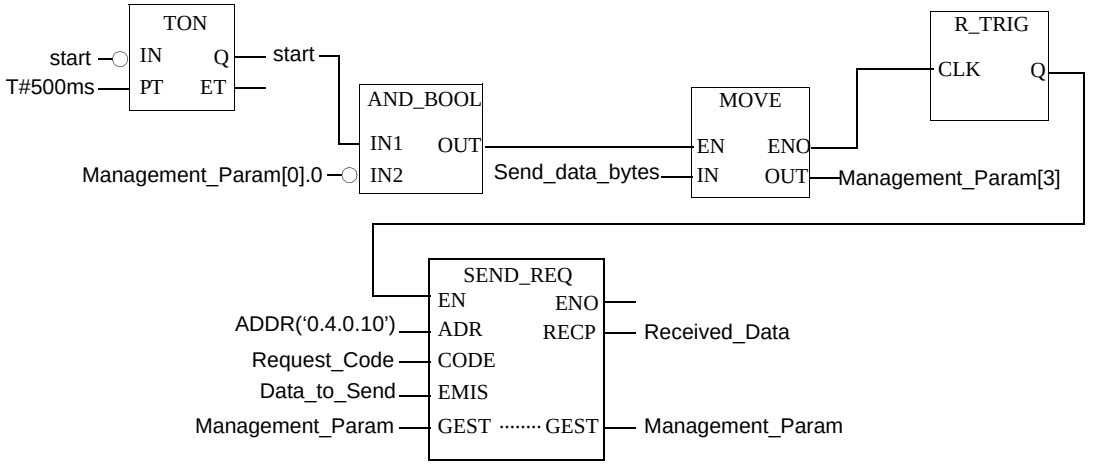
Overview

The following unconnected explicit messaging example shows you how to use the SEND_REQ function block to retrieve the switch status (Ethernet Switch Agent Object-Class 149 (hex 95), Instance 1, Attribute ID1)—using the Get_Attributes_Single service.

You can perform the same explicit messaging service using the Online Action window of the Unity Pro EtherNet/IP configuration tool..

Implementing the SEND_REQ Function Block

To implement the SEND_REQ function block, you need to create and assign variables for the following blocks, as follows:



Input Variables

Variables need to be created and assigned to input pins. For the purpose of this example, variables have been created—and named—as described below. (You can, of course, use different variable names in your explicit messaging configurations.)

Input pin	Variable	Data type
IN	start	BOOL
IN	Send_data_bytes	INT
CODE	Request_Code	INT
EMIS	Data_to_Send	Array [0...4] of 5 INT

Input/Output Variables

A single variable needs to be created and assigned to the dual input/output GEST pins. For the purpose of this example, a variable has been created—and named—as described below. (You can, of course, use different variable names in your explicit messaging configurations.)

Input pin	Variable	Data type
GEST	Management_Param	Array [0...3] of 4 INT

Output Variables

A variable also needs to be created and assigned to the single RECP output pin. (The names assigned to the output variable apply only to this example, and can be changed in your explicit messaging configurations.)

Output pin	Variable	Data type
RECP	Received_Data	Array [0...3] of 4 INT

Configuring the Address Input Parameter

To configure the Address parameter, use the ADDR function to convert a character string to an address, as follows:

- ADDR("{network.station} rack.module.channel.destination address")

Note: The parameters {network station} are required only when both the scanner and target devices are part of different networks, but the stations are connected via Fipway network.
The channel parameter value is always 0.

Note:
- The parameters {network station} are required only when both the scanner and target devices are part of different networks, but the stations are connected via Fipway network.
- The channel parameter value is always 0.

For this example, the Address Input Parameter is: ADDR{0.2.0.41}.]

Configuring the Request_Code Variable

The Request_Code variable identifies the function type for the `SEND_REQ` function block—in this case, a CIP request:

Variable	Description	Value (hex)
Request_Code	Code identifies a CIP request	16#000E

Configuring the Data_to_Send Variable

The Data_to_Send variable identifies the type of explicit message and the CIP request:

Variable	Description	Value (hex)
Data_to_Send[0]	Message type: ● 0000 (unconnected), or ● 0001 (connected) In this example, unconnected is selected.	16#0000
Data_to_Send[1]	High byte = Request path size (03) Low byte = Service: Get_Attribute_Single (0E)	16#030E
Data_to_Send[2]	High byte = Class (01) Low byte = Class Segment (20)	16#9520
Data_to_Send[3]	High byte = Instance (01) Low byte = Instance Segment (24)	16#0124
Data_to_Send[4]	High byte = Attribute (01) Low byte = Attribute Segment (30)	16#0130

Configuring the Management_ Param Variable

The Management_Param variable manages the explicit message:

Variable	Description	Value (hex)
Management_Param[0]	High byte = Exchange number (managed by system) Low byte = Activity bit (managed by system)	(read-only)
Management_Param[1]	High byte = Operation report Low byte = Communication report	(read-only)
Management_Param[2]	Timeout in ms—0 indicates infinite	16#0000
Management_Param[3]	At input = Length of Data_to_Send variable (in bytes) At output = Length of Received_Data variable (in bytes)	16#000A

Create and Configure the Send_data_ bytes Variable

The Send_data_bytes variable is used to specify the number of bytes in the explicit message to be sent to the end deice. It is copied into the Management_Param(3) variable before the send_req is activated.

For this example the number of bytes is 10 decimal (A hex).

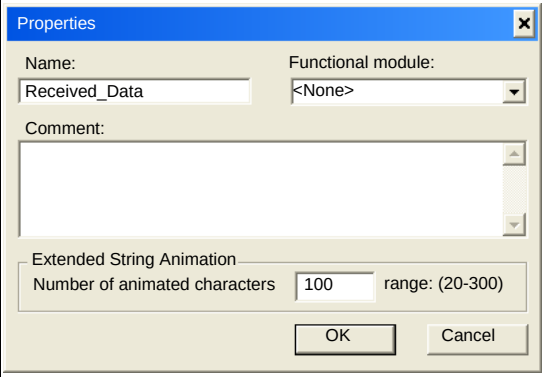
A single variable needs to be created to specify the length of data to send.

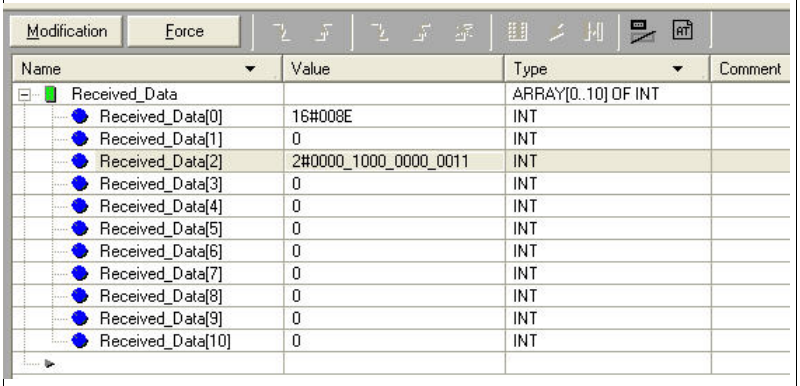
Variable	Description	Value (hex)
Data_to_Send[0]	Message type: ● 0000 (unconnected), or ● 0001 (connected) In this example, unconnected is selected.	16#0000
Data_to_Send[1]	High byte = Request path size (03) Low byte = Service: Get_Attribute_Single (0E)	16#030E
Data_to_Send[2]	High byte = Class (01) Low byte = Class Segment (20)	16#9520
Data_to_Send[3]	High byte = Instance (01) Low byte = Instance Segment (24)	16#0124
Data_to_Send[4]	High byte = Attribute (01) Low byte = Attribute Segment (30)	16#0130

Viewing the Response

Use a Unity Pro Animation table to display the Received_Data variable array. The Received_Data variable array consists of the entire data buffer.

To display the CIP response, follow these steps:

Step	Action	
1	In Unity Pro, select Tools → Project Browser to open the Project Browser.	
2	In the Project Browser, select the Animation Tables folder, then click the right mouse button. A pop-up menu appears.	
3	Select New Animation Table in the pop-up menu. A new animation table and its Properties dialog both open.	
4	In the Properties dialog, edit the following values:	
	Name	Type in a table name. For this example: Received_Data.
	Functional module	Accept the default <None>.
	Comment	(Optional) Type your comment here.
	Number of animated characters	Type in 100, representing the size of the data buffer in words.
5	The completed Properties dialog looks like this:  Click OK to close the dialog.	
6	In the animation table's Name column, type in the name of the variable assigned to the databuffer, Received_Data, and press Enter. The animation table displays the Received_Data variable.	

Step	Action
7	Expand the Received_Data variable to display its word array, where you can view the CIP response at Received_Data(0-4):  **Note:** Each array entry presents 2 bytes of data in little endian format, where the least significant byte is stored in the smallest memory address. For example, ‘8E’ in word[0] is the lower byte, and ‘00’ is the upper byte.

Name	Value	Type	Comment
Received_Data		ARRAY[0..10] OF INT	
Received_Data[0]	16#008E	INT	
Received_Data[1]	0	INT	
Received_Data[2]	2#0000_1000_0000_0011	INT	
Received_Data[3]	0	INT	
Received_Data[4]	0	INT	
Received_Data[5]	0	INT	
Received_Data[6]	0	INT	
Received_Data[7]	0	INT	
Received_Data[8]	0	INT	
Received_Data[9]	0	INT	
Received_Data[10]	0	INT	

In the above figure, the Received_Data(2) variable shows the Ethernet Switch Agent Object (class 149, instance 1, attribute 1) Switch Status.

For this example the hex value 0803 translates to the following:

- Bit 0 = 1 Overall State Inoperative
- Bit 1 = 1 Power Supply 1 Inoperative (as previously noted, only Power Supply 2 is connected)
- Bit 11 - 1 Signal Contact Open

10.3 Configuring the TSCESM Switch as an EtherNet/IP Adapter in a Quantum System

At a Glance

Introduction

This section describe the configuration of a TSCESM switch as an EtherNet/IP adapter in a Quantum system using Unity Pro software

What's in this Section?

This section contains the following topics:

Topic	Page
Overview of the TCSESM EtherNet/IP Quantum Network Setup	205
Adding an EDS File	207
Automatically Detect and Add the TESESM Switch	210
Configuring the TCSESM Switch Properties	212
Viewing the TCSESM Switch Data	215
MPB_MSTR Example-Get_Attributes_Single	217

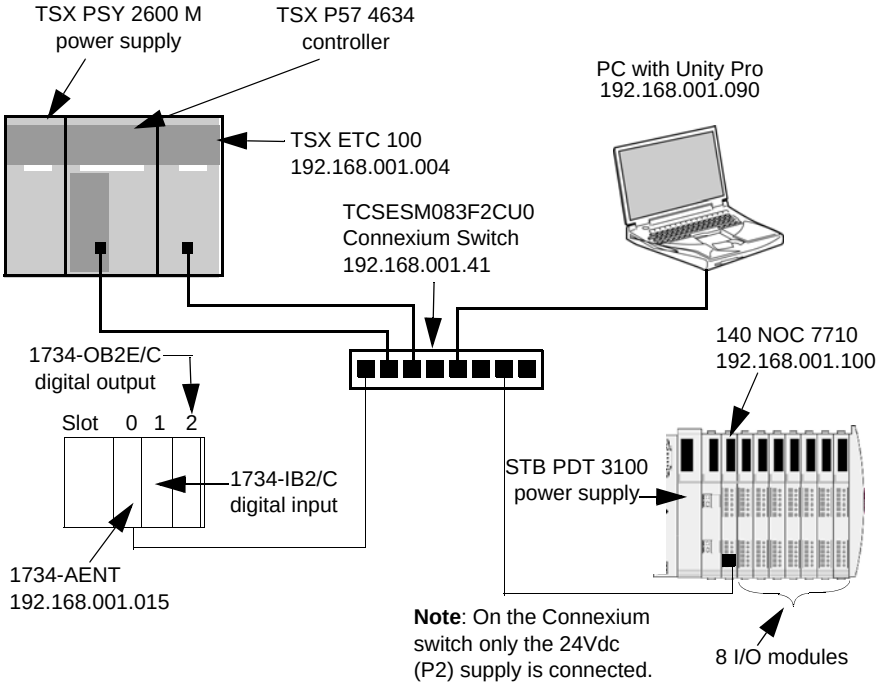
Overview of the TCSESM EtherNet/IP Quantum Network Setup

Introduction

The addition of the EtherNet/IP function to Schneider's Connexium Managed Switch product line allows the ESM to be configured as an EtherNet/IP adapter in a Quantum system using a 140 NOC 77100 EtherNet/IP module. An example of such an arrangement is described below.

Network Topology

The required hardware and the connections involved to develop a network topology looks like this:



To re-create this example, be sure to:

- use the IP addresses for your own configuration's:
  - PC
  - TSX ETC 100 EtherNet/IP communication module
  - STB NIC 2212 EtherNet/IP network interface module
  - 1734-AENT PointIO adapter
- check all wiring

Note: Unity Pro software running in the PC is used to configure the TSX P57 4634 controller. In this example, the PC is indirectly wired to the CPU's Ethernet port via the Ethernet switch. Alternatively, you could bypass the switch and directly wire the PC to another one of the CPU's ports.

Refer to the *Quantum 140 NOC 77100 EtherNet/IP Communication Module User Manual (31008209)* for complete details on configuring a Quantum EtherNet/IP system.

Adding an EDS File

Overview

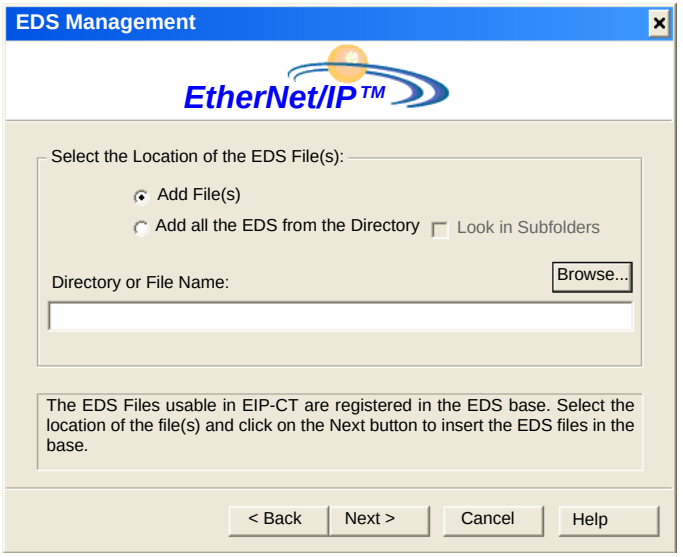
Before the TCSESM switch can be configured in a Quantum system, the TCSESM EDS file has to be added to the Unity Pro EtherNet/IP configuration tool's Device Library.The tool includes an EDS Management wizard that you can use to add one or more EDS files to the Device Library. The wizard presents a series of instruction screens that:

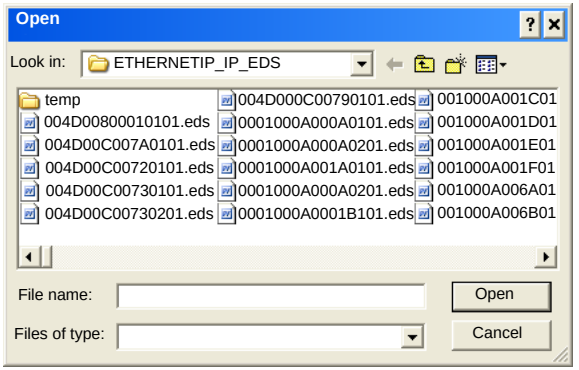
- simplify the process of adding EDS files to the Device Library, and
- provide a redundancy check in case you attempt to add duplicate EDS files to the Device Library

Note: During the following procedure, you can select Devices → Options... to open the Display Options window, where you can enable/disable messages indicating the EDS file you are adding is a duplicate—or a different version—of an existing EDS file.

Adding EDS Files

To add one or more EDS files to the Device Library:

Step	Action
1	Open the Unity project with ETC configured.
2	Open the ETC module properties.
3	Click on the EtherNet/IP button to open the EIP configuration tool.
4	Do one of the following: ● in the Device Library, click the Add button , or ● select Library → Add Page 1 of the wizard opens.
5	Click Next. Page 2 of the wizard opens: 
6	In the Select the Location of the EDS File(s) section, select either: ● Add File(s), to add one or more EDS files you will individually select, or ● Add all the EDS Files from the Directory, to add all files from a folder you will select. ● Select Look in Subfolders to also add EDS files in subfolders beneath the folder you select

Step	Action
7	Click the Browse button. The Open dialog opens. 
8	Use the Open dialog to navigate to and select: ● one or more EDS files, or ● a folder containing EDS files
9	After you have made your selection(s), click Open. The dialog closes and your selection appears in the Directory or File Name field.
10	Click Next. The wizard compares the selected EDS files against existing files in the Device Library.
11	(Conditional) If one or more selected EDS files are duplicates and if notice of redundant files is enabled in the Display Options dialog, a File Already Exists message displays. Close the message.
12	Page 3 of the wizard opens indicating the status of each device you attempted to add: ● a green check mark indicates the EDS file can be added ● a blue informational icon indicates a redundant file ● a red check mark indicates an invalid EDS file (Optional) Select a file in the list, then click View Selected File to open it.
13	Click Next to add the non-duplicate files. Page 4 of the wizard opens, indicating the action is complete.
14	Click Finish to close the wizard. The device(s) you added can now be inserted into your EtherNet/IP configuration.

Automatically Detect and Add the TESESM Switch

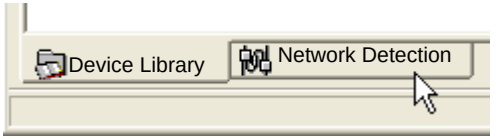
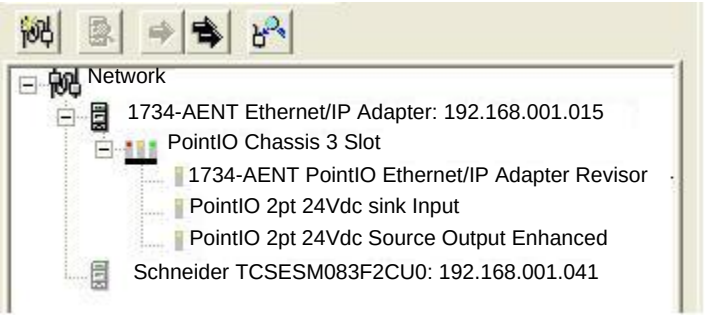
Overview

Use the Unity Pro EtherNet/IP configuration tool to automatically detect the TCSESM switch. After it is detected, you can add it to your project.

Note: The TCSESM must be active online with a valid IP address before you can detect and add it to your project.

Detecting and Adding Network Devices

To automatically detect the TCSESM and then add it to your project, follow these steps:

Step	Action
1	Launch the configuration tool from the Configuration page of the EtherNet/IP communication module's Properties window.
2	In the configuration tool, begin on-line operations by clicking the Go Online button .
3	Click on the Configuration tab to enable automatic network detection: 
4	Click the Read Network Configuration toolbar button . The configuration tool searches the network for EtherNet/IP devices, classifies them using the device EDS file, then lists the EtherNet/IP devices it detects. 
5	Select the 1734-AENT PointIO Adapter in Network Detection window.
6	Click the Insert in Configuration button . The Properties window opens, where you can configure the 1734-AENT PointIO adapter.

Configuring the TCSESM Switch Properties

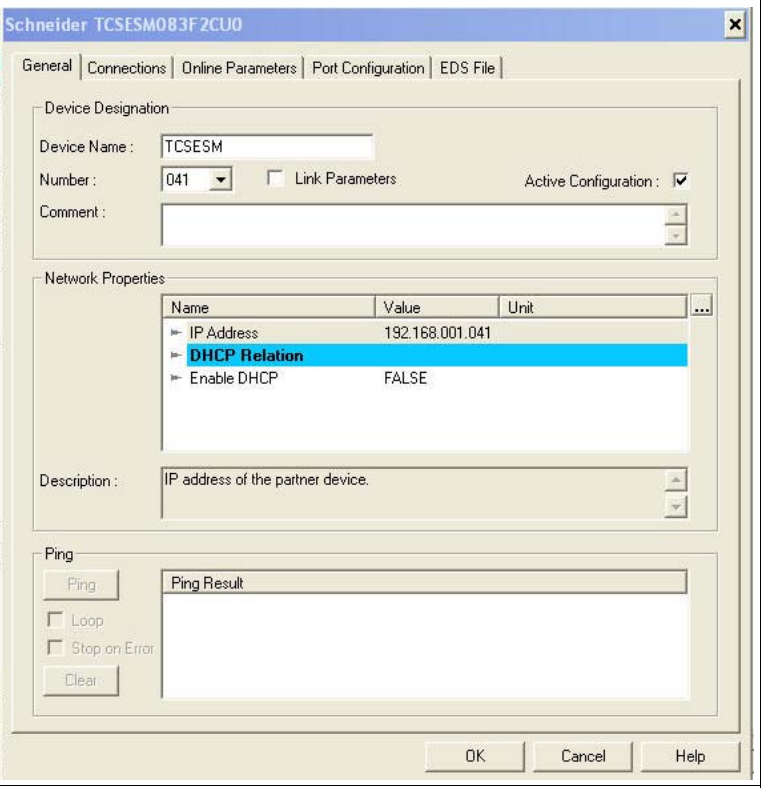
Overview

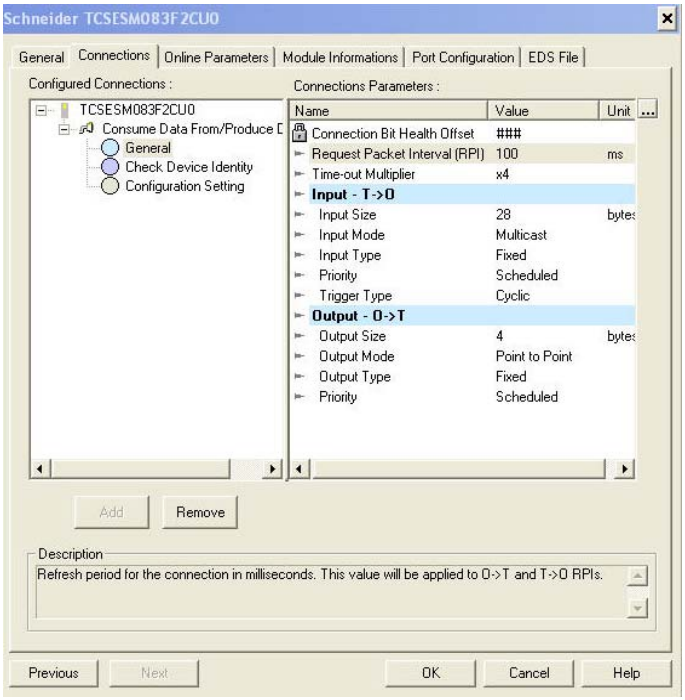
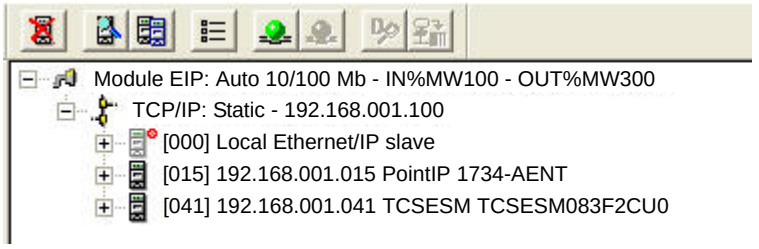
The TCSESM switch Properties window presents the following tabbed pages. Only some of these pages need to be edited for this example:

In this page...	Do the following...
General	• input device name • configure IP address • add the device to the project configuration
Connections	Accept the default settings.
Online Parameters	Accept the default settings, if any.
Module Informations	(Read-only page - no configuration required)
Port Configuration	(Read-only page - no configuration required)
EDS File	(Read-only page - no configuration required)

Configuring the TCSESM

The following settings were used in the sample configuration:

Step	Action	
1	Click on the General page: 	
2	In the General page, edit the following settings:	
	Device Name	**TCSESM**
	Number	The sequence of the device in the Devices window. for this example, type in **041**.
	Active Configuration	Be sure this checkbox is selected.
	IP Address	**192.168.001.041**

Step	Action
3	Click on the Connection page: 
4	Under Configured Connections select General.
5	Under Connection Parameters select Request Packet Interval (RPI).
6	Select and change the value to **100**.
7	Click OK to save your settings and close the properties window. A node is added to the project configuration in the Devices window:  The next step is to view the remote device's inputs and outputs.

Viewing the TCSESM Switch Data

Overview

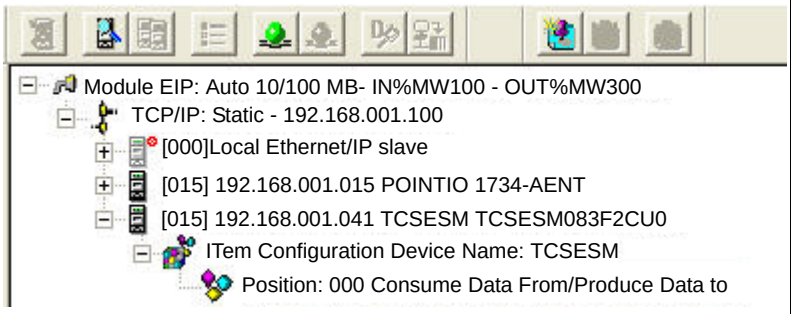
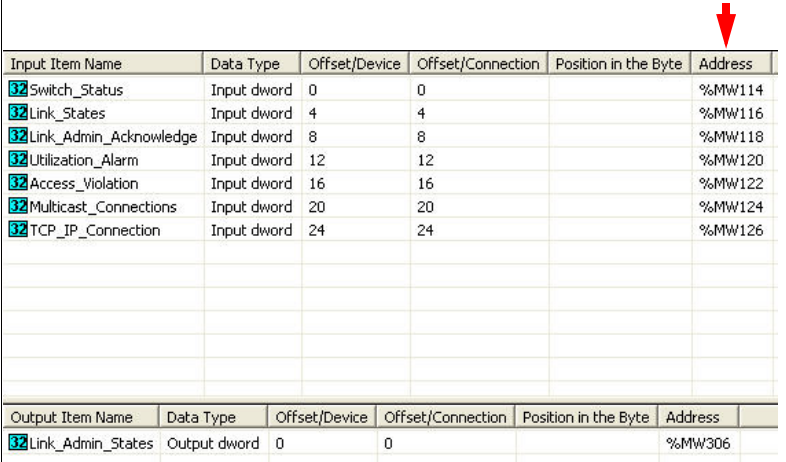
Because the Device Library includes EDS files for the TSCESM switch PointIO adapter and its discrete input and output modules, the Unity Pro EtherNet/IP configuration tool automatically:

- creates a single rack optimized CIP connection from the TCSESM's EtherNet/IP communication module to the 1734-AENT, and
- configures each input and output item by assigning:
  - an item name
  - an address location
  - a size allotment based on its data type

Note: In this example, the configuration tool created a single rack optimized connection, which is a more efficient use of CIP connections. A rack optimized connection can be used only with discrete (digital) I/O modules. For analog I/O modules, each analog module must be connected to the TCSESM using a separate connection.

Viewing the CIP Connection and I/O

To view the automatically created CIP connection and the I/O items in the Unity Pro EtherNet/IP configuration tool:

Step	Action
1	In the Protocol window, navigate to and select Position: 000 Consume Data From/ Produce Data to as shown below:  The automatically configured input and output items appear on the right side of the screen in the I/O area (shown below).
2	If necessary, use the horizontal scroll bar to scroll to the far right of the input or output area and display the Address column, which identifies the location of the input or output in the TSX ETC 100:  Input Item Name: Switch_Status, Data Type: Input dword, Offset/Device: 0, Offset/Connection: 0, Address: %MW114 Input Item Name: Link_States, Data Type: Input dword, Offset/Device: 4, Offset/Connection: 4, Address: %MW116 Input Item Name: Link_Admin_Acknowledge, Data Type: Input dword, Offset/Device: 8, Offset/Connection: 8, Address: %MW118 Input Item Name: Utilization_Alarm, Data Type: Input dword, Offset/Device: 12, Offset/Connection: 12, Address: %MW120 Input Item Name: Access_Violation, Data Type: Input dword, Offset/Device: 16, Offset/Connection: 16, Address: %MW122 Input Item Name: Multicast_Connections, Data Type: Input dword, Offset/Device: 20, Offset/Connection: 20, Address: %MW124 Input Item Name: TCP_IP_Connection, Data Type: Input dword, Offset/Device: 24, Offset/Connection: 24, Address: %MW126 Output Item Name: Link_Admin_States, Data Type: Output dword, Offset/Device: 0, Offset/Connection: 0, Position in the Byte:, Address: %MW306

MPB_MSTR Example-Get_Attributes_Single

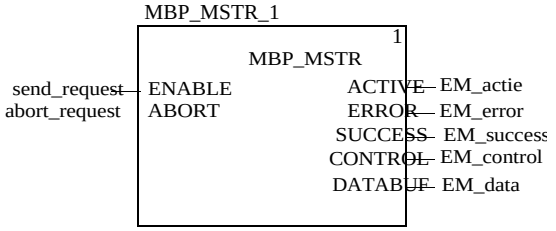
Overview

The following unconnected explicit messaging example shows you how to use the MBP_MSTR function block to retrieve the switch status [Ethernet Switch Agent Object-Class 149 (hex 95), Instance 1, Attribute ID1] module, using the Get_Attributes_Single service.

You can perform the same explicit messaging service using the Online Action window of the Unity Pro EtherNet configuration tool.

Implementing the MBP_MSTR Function Block

To implement the MBP_MSTR function block, you need to create and assign variables for the following blocks, as follows:



Input Variables

Variables need to be created and assigned to input pins. For the purpose of this example, variables have been created—and named—as described below. (You can, of course, use different variable names in your explicit messaging configurations.)

Input pin	Variable	Data type
ENABLE	send_request	BOOL
ABORT	abort_request	BOOL

Output Variables

A variable also needs to be created and assigned to output pins. (The names assigned to the output variable apply only to this example, and can be changed in your explicit messaging configurations.)

Output pin	Variable	Data type	Address
ACTIVE	EM_active	BOOL	
ERROR	EM_error	BOOL	
SUCCESS	EM_success	BOOL	
CONTROL	EM_control	Array of 9 words	% MW500
DATABUF	EM_data	Array of 100 words	% MW600

Control Array

The control array parameter (EM_control) consists of 9 contiguous words. You need to configure only some control words; other control words are read-only and are written to by the operation. In this example, the control array defines the operation as an unconnected explicit message, and identifies the target device.

Register	Description	Configure	Setting (hex)
CONTROL [0]	Operation: Low byte = OE (CIP explicit message) High byte = ● 00 (unconnected), or ● 01 (connected)	Yes	16#000E (unconnected)
CONTROL [1]	Status: read-only (written by operation).	No	—
CONTROL [2]	Data buffer length = 100 words	Yes	16#0004
CONTROL [3]	Response offset: offset–in words–for the beginning of the explicit message response in the databuffer	Yes	16#0004
CONTROL [4]	Slot of the 140 NOC 771 00 module: Low byte = 0 (not used) High byte = slot location	Yes	16#0004
CONTROL [5]	Device number: from the Devices window of the Unity Pro EtherNet/IP configuration tool	Yes	16#0029
CONTROL [6]	CIP request length (in bytes)	Yes	16#0008
CONTROL [7]	Length of received response (written by operation)	No	—
CONTROL [8]	(Reserved)	No	—

Configuration of the Management Param Variable

The Management_Param variable manages the explicit message:

Variable	Description	Value (hex)
Management_Param[0]	High byte = Exchange number (managed by system) Low byte = Activity bit (managed by system)	(read-only)
Management_Param[1]	High byte = Operation report Low byte = Communication report	(read-only)
Management_Param[2]	Timeout in ms—0 indicates infinite	16#0000
Management_Param[3]	At input = Length of Data_to_Send variable (in bytes) At output = Length of Received_Data variable (in bytes)	16#000A

CIP Request

The CIP request is located at the beginning of the databuffer and is followed by the CIP response. In this example, the CIP request calls for the return of a single attribute value (switch state), and describes the request path through the target device's object structure leading to the target attribute:.

Request word	High byte		Low byte	
	Description	Value (hex)	Description	Value (hex)
1	Request path size (in words)	16#03	EM Service: Get_Attributes_Single	16#OE
2	Request path: class assembly object	16#95	Request path: logical class segment	16#20
3	Request path: Instance	16#01	Request path: logical instance segment	16#24
4	Request path: attribute	16#01	Request path: logical attribute segment	16#30

Combining the high and low bytes, above, the CIP request would look like this:

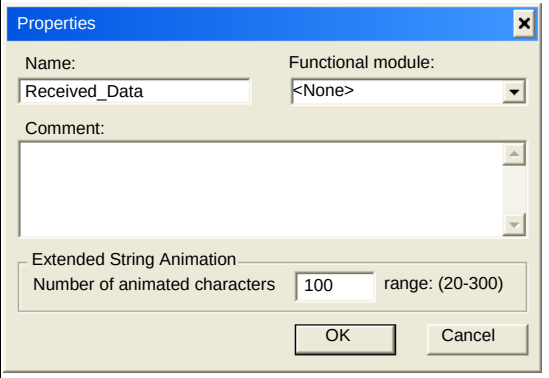
Request word	Value
1	16#030E
2	16#9520
3	16#0124
4	16#0130

Viewing the Response

Use a Unity Pro Animation table to display the Received_Data variable array. The Received_Data variable array consists of the entire data buffer, which includes:

- CIP request (4 words) located in EM_data(1-4)
- CIP service type (1 word) located in EM_data(5)
- CIP request status (1 word) located in EM_data(6)
- CIP response (in this case, 10 words) located in EM_data(7-16)

To display the CIP response, follow these steps:

Step	Action	
1	In Unity Pro, select Tools → Project Browser to open the Project Browser.	
2	In the Project Browser, select the Animation Tables folder, then click the right mouse button. A pop-up menu appears.	
3	Select New Animation Table in the pop-up menu. A new animation table and its Properties dialog both open.	
4	In the Properties dialog, edit the following values:	
	Name	Type in a table name. For this example: Received_Data.
	Functional module	Accept the default <None>.
	Comment	(Optional) Type your comment here.
	Number of animated characters	Type in 100, representing the size of the data buffer in words.
5	The completed Properties dialog looks like this:  Click **OK** to close the dialog.	
6	In the animation table's Name column, type in the name of the variable assigned to the databuffer: Received_Data and press Enter. The animation table displays the Received_Data variable.	

Step	Action
7	Expand the Received_Data variable to display its word array, where you can view the CIP response at Received_Data(0-4): Modification Force Name Value Type Comment Address EM_data ARRAY[0..99] OF WORD %Mw600 EM_data[0] 16#030E WORD %MW600 EM_data[1] 16#9520 WORD %MW601 EM_data[2] 16#0124 WORD %MW602 EM_data[3] 16#0130 WORD %MW603 EM_data[4] 16#008E WORD %MW604 EM_data[5] 0 WORD %MW605 EM_data[6] 16#0803 WORD %MW606 EM_data[7] 0 WORD %MW607 EM_data[8] 0 WORD %MW608 EM_data[9] 0 WORD %MW609 EM_data[10] 0 WORD %MW610 EM_data[11] 0 WORD %MW611 EM_data[12] 0 WORD %MW612 EM_data[13] 0 WORD %MW613 EM_data[14] 0 WORD %MW614 **Note:** Each array entry presents 2 bytes of data in little endian format, where the least significant byte is stored in the smallest memory address. For example, ‘8E’ in word[0] is the lower byte, and ‘00’ is the upper byte.

In the above figure, the EM_data(6) variable shows the Ethernet Switch Agent Object (class 149), instance 1, attribute 1) Switch Status.

For this example the hex value 0803 translates to the following:

- Bit 0 = 1 Overall State Inoperative
- Bit 1 = 1 Power Supply 1 Inoperative (as previously noted, only Power Supply 2 is connected)
- Bit 11 - 1 Signal Contact Open

Appendices

At a Glance

What's in this Appendix?

The appendix contains the following chapters:

Chapter	Chapter Name	Page
A	General Information	225
B	Switch Function Examples	281

General Information

A

The Management Information Base (MIB)

MIB Description

The Management Information Base (MIB) is designed in the form of an abstract tree structure.

The branching points are the *object classes*. The leaves of the MIB are called *generic object classes*. Wherever necessary for unambiguous identification, the generic object classes are instantiated, i.e. the abstract structure is imaged on the reality, by specifying the port address or the source address.

Values (integers, time ticks, counters or octet strings) are assigned to these instances. These values can be read and, in some cases, modified. The object description or *object ID* (OID) identifies the object class. The subidentifier (SID) is used for instantiation.

Example:

The generic object class

`saPSState (OID = 1.3.6.1.4.1.3833.1.1.14.1.2.1.3)`

is the description of the abstract information power supply state. It is, however, not possible to read any information from this, as the system does not know which power supply is meant.

Specification of the subidentifier (2) images this abstract information on the reality (instantiates it), which means that it refers to power supply 2. A value is assigned to this instance and can then be read.

The instance get `1.3.6.1.4.1.248.14.1.2.1.3` **2**, for example, returns the response 1, which means that the power supply is ready for operation.

MIB Abbreviations

The following table defines the abbreviations used in the MIB.

Abbreviation	Meaning
Comm	Group access rights
Con	Configuration
Descr	Description
Fan	Fan
ID	Identifier
Lwr	Lower (e.g., threshold)
PS	Power supply
Pwr	Supply voltage
sys	System
UI	User Interface
Upr	Upper (e.g., threshold)
ven	Vendor (Schneider Electric)

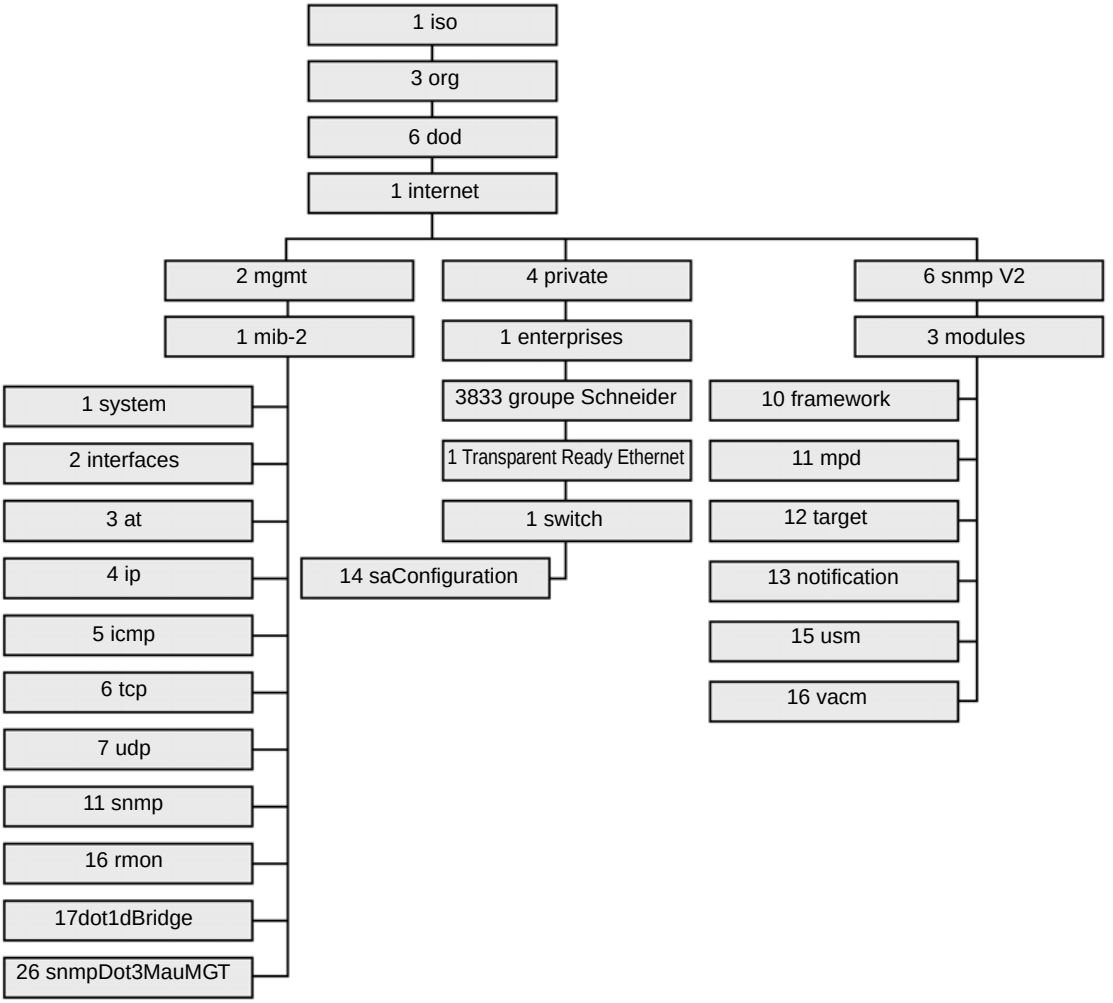
Syntax Definitions

The following table defines the syntax terms used in the MIB.

Term	Definition
Integer	an integer in the range 0-2^{32}
IP address	xxx.xxx.xxx.xxx (xxx = integer in the range 0-255)
MAC address	12-digit hexadecimal number in accordance with ISO / IEC 8802-3
Object Identifier	x.x.x.x... (e.g., 1.3.6.1.1.4.1.3833...)
Octet String	ASCII character string
PSID	power supply identifier (power supply number)
Time Ticks	Stopwatch elapsed time (in seconds) = numerical value / 100 numerical value = integer in the range 0-2^{32}
Timeout	time value in hundredths of a second time value = integer in the range 0-2^{32}
Type Field	4-digit hexadecimal number in accordance with ISO / IEC 8802-3
Counter	Integer (0-2^{32}) whose value is incremented by 1 when certain events occur.

MIB Tree Structure

The following flowchart describes the tree structure of the ESM MIB.



Note: Not all devices support all object classes. The value not supported is given in response to a non-supported object class request. Any attempt to alter a non-supported object class produces the message bad value.

MIB II

System Group (1.3.6.1.2.1.1)

The system group is a required group for all systems. It contains system-related objects. If an agent has no value for a variable, then the response returned includes a string of length 0.

```
(1) system
  |-- (1) sysDescr
  |-- (2) sysObjectID
  |-- (3) sysUpTime
  |-- (4) sysContact
  |-- (5) sysName
  |-- (6) sysLocation
  |-- (7) sysServices
  |-- (8) sysORLastChange
  |-- (9) sysORTable
    |-- (1) sysOREntry
      |-- (1) sysORIndex
      |-- (2) sysORID
      |-- (3) sysDescr
      |-- (4) sysORUpTime
```

System Group Objects

The following table describes the member objects of the system group.

Object	OID	Syntax	Access	Description
sysDescr	1.3.6.1.2.1.1.1.0	ASCII String (Size: 0-255	Read	Is a verbal description of the entry. This value should contain the full name and version number of type of system hardware, operating system software, and network software. The description must consist only of printable ASCII characters.
sysObjectID	1.3.6.1.2.1.1.2.0	Object identifier	Read	Is the authorization identification of the manufacturer of the network management system that is integrated in this device. This value is placed in the SMI enterprises subtree (1.3.6.1.4.1) and describes which type of device is being managed. For example: if the manufacturer **Schneider Electric** is assigned the subtree 1.3.6.1.4.1.3833, then he can assign his switch the identifier 1.3.6.1.4.1.3833.1.1.
sysUpTime	1.3.6.1.2.1.1.3.0	Time ticks	Read	Is the time in 1/100 seconds since the last reset of the network management unit.
sysContact	1.3.6.1.2.1.1.4.0	ASCII string (size: 0-255)	Read and write	Is the clear-text identification of the contact person for this managed node along with the information about how that person is to be contacted.
sysName	1.3.6.1.2.1.1.5.0	ASCII string (size: 0-255)	Read and write	Is a name for this node for identifying it for administration. By convention, this is the fully qualified name in the domain.
sysLocation	1.3.6.1.2.1.1.6.0	ASCII string (size: 0-255)	Read and write	the physical location of this node (e.g., staircase, 3rd floor)
sysServices	1.3.6.1.2.1.1.7.0	Integer (0-127)	Read	This value indicates the services offered by the node. It is an integral value calculated by summing $2^{(layer - 1)}$ for each ISO layer for which the node provides service. For example: A node primarily provides routing functions (OSI layer 3): sysServices = $2^{(3-1)} = 4$ A node is a host and offers application and network services (OSI layers 4 and 7): sysServices = $2^{(4-1)} + 2^{(7-1)} = 72$

Interface Group (1.3.6.1.2.1.2)

The interface group contains information about the device interfaces.

```
(2) interfaces
   |-- (1) ifNumber
   |-- (2) ifTable
      |-- (1) ifEntry
         |-- (1) ifIndex
         |-- (2) ifDescr
         |-- (3) ifType
         |-- (4) ifMtu
         |-- (5) ifSpeed
         |-- (6) ifPhysAddress
         |-- (7) ifAdminStatus
         |-- (8) ifOperStatus
         |-- (9) ifLastChange
         |-- (10) ifInOctets
         |-- (11) ifInUcastPkts
         |-- (12) ifInNUcastPkts
         |-- (13) ifInDiscards
         |-- (14) ifInErrors
         |-- (15) ifInUnknownProtos
         |-- (16) ifOutOctets
         |-- (17) ifOutUcastPkts
         |-- (18) ifOutNUcastPkts
         |-- (19) ifOutDiscards
         |-- (20) ifOutErrors
         |-- (21) ifOutQLen
         |-- (22) ifSpecific
```

Address Translation Group (1.3.6.1.2.1.3)

The address translation group is required for all systems. It contains information about the assignment of addresses.

(3) at

|-- (1) atTable

|-- (1) atEntry

|-- (1) atIfIndex

|-- (2) atPhysAddress

|-- (3) atNetAddress

Internet Protocol Group (1.3.6.1.2.1.4)

The internet protocol group is required for all systems. It contains information affecting IP switching.

(4) ip

|-- (1) ipForwarding

|-- (2) ipDefaultTTL

|-- (3) ipInReceives

|-- (4) ipInHdrErrors

|-- (5) ipInAddrErrors

|-- (6) ipForwDatagrams

|-- (7) ipInUnknownProtos

|-- (8) ipInDiscards

|-- (9) ipInDelivers

|-- (10) ipOutRequests

|-- (11) ipOutDiscards

|-- (12) ipOutNoRoutes

|-- (13) ipReasmTimeout

|-- (14) ipReasmReqds

|-- (15) ipReasmOKs

|-- (16) ipReasmFails

|-- (17) ipFragOKs

|-- (18) ipFragFails

|-- (19) ipFragCreates

|-- (20) ipAddrTable

|-- (1) ipAdEntAddr

|-- (1) ipAdEntAddr

```
        |-- (2) ipAdEntIfIndex
        |-- (3) ipAdEntNetMask
        |-- (4) ipAdEntBcastAddr
        |-- (5) ipAdEntReasmMaxSize
|-- (21) ipRouteTable
|   |-- (1) ipRouteEntry
        |-- (1) ipRouteDest
        |-- (2) ipRouteIfIndex
        |-- (3) ipRouteMetric1
        |-- (4) ipRouteMetric2
        |-- (5) ipRouteMetric3
        |-- (6) ipRouteMetric4
        |-- (7) ipRouteNextHop
        |-- (8) ipRouteType
        |-- (9) ipRouteProto
        |-- (10) ipRouteAge
        |-- (11) ipRouteMask
        |-- (12) ipRouteMetric5
        |-- (13) ipRouteInfo
|-- (22) ipNetToMediaTable
|   |-- (1) ipNetToMediaEntry
|       |-- (1) ipNetToMediaIfIndex
|       |-- (2) ipNetToMediaPhysAddress
|       |-- (3) ipNetToMediaNetAddress
|       |-- (4) ipNetToMediaType
|-- (23) ipRoutingDiscards
```

ICMP Group (1.3.6.1.2.1.5)

The internet control message protocol group is obligatory for all systems. It contains all the information on status handling and control for data exchange in the Internet.

(5) icmp

|-- (1) icmpInMsgs

|-- (2) icmpInMsgs

|-- (3) icmpInDestUnreachs

|-- (4) icmpInTimeExcds

|-- (5) icmpInParmProbs

|-- (6) icmpInSrcQuenchs

|-- (7) icmpInRedirects

|-- (8) icmpInEchos

|-- (9) icmpInEchoReps

|-- (10) icmpInTimestamps

|-- (11) icmpInTimestampReps

|-- (12) icmpInAddrMasks

|-- (13) icmpInAddrMaskReps

|-- (14) icmpOutMsgs

|-- (15) icmpOutErrors

|-- (16) icmpOutDestUnreachs

|-- (17) icmpOutTimeExcds

|-- (18) icmpOutParmProbs

|-- (19) icmpOutSrcQuenchs

|-- (20) icmpOutRedirects

|-- (21) icmpOutEchos

|-- (22) icmpOutEchoReps

|-- (23) icmpOutTimestamps

|-- (24) icmpOutTimestampReps

|-- (25) icmpOutAddrMasks

|-- (26) icmpOutAddrMaskReps

Transfer Control Protocol Group (1.3.6.1.2.1.6)

The transfer control protocol group is required for all systems that have implemented TCP. Instances of objects that describe information about a particular TCP connection exist only as long as the connection exists.

```
(6) tcp
   |-- (1) tcpRtoAlgorithm
   |-- (2) tcpRtoMin
   |-- (3) tcpRtoMax
   |-- (4) tcpMaxConn
   |-- (5) tcpActiveOpens
   |-- (6) tcpPassiveOpens
   |-- (7) tcpAttemptFails
   |-- (8) tcpEstabResets
   |-- (9) tcpCurrEstab
   |-- (10) tcpInSegs
   |-- (11) tcpOutSegs
   |-- (12) tcpRetransSegs
   |-- (13) tcpConnTable
   |   |-- (1) tcpConnEntry
   |       |-- (1) tcpConnState
   |       |-- (2) tcpConnLocalAddress
   |       |-- (3) tcpConnLocalPort
   |       |-- (4) tcpConnRemAddress
   |       |-- (5) tcpConnRemPort
   |-- (14) tcpInErrs
   |-- (15) tcpOutRsts
```

User Datagram Protocol Group (1.3.6.1.2.1.7)

The user datagram protocol group is required for all systems that have implemented UDP.

(7) udp

|-- (1) udpInDatagrams

|-- (2) udpNoPorts

|-- (3) udpInErrors

|-- (4) udpOutDatagrams

|-- (5) udpTable

| |-- (1) udpEntry

| |-- (1) udpLocalAddress

| |-- (2) udpLocalPort

Simple Network Management Protocol Group (1.3.6.1.2.1.11)

The simple network management protocol group is required for all systems. In SNMP installations that have been optimized to support either just one agent or one management station, some of the listed objects will contain the value **O**.

(11) snmp

|-- (1) snmpInPkts

|-- (2) snmpOutPkts

|-- (3) snmpInBadVersions

|-- (4) snmpInBadCommunityNames

|-- (5) snmpInBadCommunityUses

|-- (6) snmpInASNParseErrs

|-- (7) not used

|-- (8) snmpInTooBigs

|-- (9) snmpInNoSuchNames

|-- (10) snmpInBadValues

|-- (11) snmpInReadOnlys

|-- (12) snmpInGenErrs

|-- (13) snmpInTotalReqVars

|-- (14) snmpInTotalSetVars

|-- (15) snmpInGetRequests

|-- (16) snmpInGetNexts

|-- (17) snmpInSetRequests

|-- (18) snmpInGetResponses

|-- (19) snmpInTraps

|-- (20) snmpOutTooBigs

|-- (21) snmpOutNoSuchNames

|-- (22) snmpOutBadValues

|-- (23) not used

|-- (24) snmpOutGenErrs

|-- (25) snmpOutGetRequests

|-- (26) snmpOutGetNexts

|-- (27) snmpOutSetRequests

|-- (28) snmpOutGetResponses

|-- (29) snmpOutTraps

|-- (30) snmpEnableAuthenTraps

|-- (31) snmpSilentDrops

|-- (32) snmpProxyDrops

RMON Group (1.3.6.1.2.1.16)

This part of the MIB provides a continuous flow of current and historical network component data to the network management. The configuration of alarms and events controls the evaluation of network component counters. The agents inform the management station of the evaluation result by means of traps depending on the configuration.

(16 rmon

|--(1) statistics

|--(1) etherStatsTable

|--(1) etherStatsEntry

|--(1) etherStatsIndex

|--(2) etherStatsDataSource

|--(3) etherStatsDropEvents

|--(4) etherStatsOctets

|--(5) etherStatsPkts

|--(6) etherStatsBroadcastPkts

|--(7) etherStatsMulticastPkts

|--(8) etherStatsCRCAlignErrors

|--(9) etherStatsUndersizePkts

|--(10) etherStatsOversizePkts

|--(11) etherStatsFragments

```
            |--(12) etherStatsJabbers
            |--(13) etherStatsCollisions
            |--(14) etherStatsPkts64Octets
            |--(15) etherStatsPkts65to127Octets
            |--(16) etherStatsPkts128to255Octets
            |--(17) etherStatsPkts256to511Octets
            |--(18) etherStatsPkts512to1023Octets
            |--(19) etherStatsPkts1024to1518Octets
            |--(20) etherStatsOwner
            |--(21) etherStatsStatus
|--(2) history
   |--(1) historyControlTable
      |--(1) historyControlEntry
         |--(1) historyControlIndex
         |--(2) historyControlDataSource
         |--(3) historyControlBucketsRequested
         |--(4) historyControlBucketsGranted
         |--(5) historyControlInterval
         |--(6) historyControlOwner
         |--(7) historyControlStatus
   |--(2) etherHistoryTable
      |--(1) etherHistoryEntry
         |--(1) etherHistoryIndex
         |--(2) etherHistorySampleIndex
         |--(3) etherHistoryIntervalStart
         |--(4) etherHistoryDropEvents
         |--(5) etherHistoryOctets
         |--(6) etherHistoryPkts
         |--(7) etherHistoryBroadcastPkts
         |--(8) etherHistoryMulticastPkts
         |--(9) etherHistoryCRCAlignErrors
         |--(10) etherHistoryUndersizePkts
         |--(11) etherHistoryOversizePkts
```

```
            |--(12) etherHistoryFragments
            |--(13) etherHistoryJabbers
            |--(14) etherHistoryCollisions
            |--(15) etherHistoryUtilization
|--(3) alarm
   |--(1) alarmTable
      |--(1) alarmEntry
            |--(1) alarmIndex
            |--(2) alarmInterval
            |--(3) alarmVariable
            |--(4) alarmSampleType
            |--(5) alarmValue
            |--(6) alarmStartupAlarm
            |--(7) alarmRisingThreshold
            |--(8) alarmFallingThreshold
            |--(9) alarmRisingEventIndex
            |--(10) alarmFallingEventIndex
            |--(11) alarmOwner
            |--(12) alarmStatus
|--(9) event
   |--(1) eventTable
      |--(1) eventEntry
            |--(1) eventIndex
            |--(2) eventDescription
            |--(3) eventType
            |--(4) eventCommunity
            |--(5) eventLastTimeSent
            |--(6) eventOwner
            |--(7) eventStatus
   |--(2) logTable
      |--(1) logEntry(1)
            |--(1) logEventIndex
            |--(2) logIndex
```

```
            |--(3) logTime
            |--(4) logDescription
   |--(19) probeConfig
      |--(15) smonCapabilities
   |--(22) switchRMON
         |--(1) smonMIBObjects
            |--(1) dataSourceCaps
               |--(1) dataSourceCapsTable
                  |--(1) dataSourceCapsEntry
                     |--(1) dataSourceCapsObject
                     |--(2) dataSourceRmonCaps
                     |--(3) dataSourceCopyCaps
                     |--(4) dataSourceCapsIfIndex
            |--(3) portCopyConfig
               |--(1) portCopyTable
                     |--(1) portCopyEntry
                     |--(1) portCopySource
                     |--(2) portCopyDest
                     |--(3) portCopyDestDropEvents
                     |--(4) portCopyDirection
                     |--(5) portCopyStatus
```

dot1dBridge (1.3.6.1.2.1.17)

This part of the MIB contains bridge-specific objects.

```
(17) dot1dBridge
   |--(1) dot1dBase
      |--(1) dot1dBaseBridgeAddress
      |--(2) dot1dBaseNumPorts
      |--(3) dot1dBaseType
      |--(4) dot1dBasePortTable
         |--(1) dot1dBasePortEntry
            |--(1) dot1dBasePort
            |--(2) dot1dBasePortIfIndex
            |--(3) dot1dBasePortCircuit
            |--(4) dot1dBasePortDelayExceededDiscards
```

```
        |--(5) dot1dBasePortMtuExceededDiscards
|--(2) dot1dStp
   |--(1) dot1dStpProtocolSpecification
   |--(2) dot1dStpPriority
   |--(3) dot1dStpTimeSinceTopologyChange
   |--(4) dot1dStpTopChanges
   |--(5) dot1dStpDesignatedRoot
   |--(6) dot1dStpRootCost
   |--(7) dot1dStpRootPort
   |--(8) dot1dStpMaxAge
   |--(9) dot1dStpHelloTime
   |--(10) dot1dStpHoldTime
   |--(11) dot1dStpForwardDelay
   |--(12) dot1dStpBridgeMaxAge
   |--(13) dot1dStpBridgeHelloTime
   |--(14) dot1dStpBridgeForwardDelay
   |--(15) dot1dStpPortTable
      |--(1) dot1dStpPortEntry
         |--(1) dot1dStpPort
         |--(2) dot1dStpPortPriority
         |--(3) dot1dStpPortState
         |--(4) dot1dStpPortEnable
         |--(5) dot1dStpPortPathCost
         |--(6) dot1dStpPortDesignatedRoot
         |--(7) dot1dStpPortDesignatedCost
         |--(8) dot1dStpPortDesignatedBridge
         |--(9) dot1dStpPortDesignatedPort
         |--(10) dot1dStpPortForwardTransitions
         |--(11) dot1dStpPortPathCost32
   |--(16) dot1dStpVersion
   |--(17) dot1dStpTxHoldCount
   |--(18) dot1dStpPathCostDefault
   |--(19) dot1dStpExtPortTable
```

```
        |--(1) dot1dStpExtPortEntry
            |--(1) dot1dStpPortProtocolMigration
            |--(2) dot1dStpPortAdminEdgePort
            |--(3) dot1dStpPortOperEdgePort
            |--(4) dot1dStpPortAdminPointToPoint
            |--(5) dot1dStpPortOperPointToPoint
            |--(6) dot1dStpPortAdminPathCost
|--(3) dot1dSr
|--(4) dot1dTp
    |--(1) dot1dTpLearnedEntryDiscards
    |--(2) dot1dTpAgingTime
    |--(3) dot1dTpFdbTable
        |--(1) dot1dTpFdbEntry
            |--(1) dot1dTpFdbAddress
            |--(2) dot1dTpFdbPort
            |--(3) dot1dTpFdbStatus
    |--(4) dot1dTpPortTable
        |--(1) dot1dTpPortEntry
            |--(1) dot1dTpPort
            |--(2) dot1dTpPortMaxInfo
            |--(3) dot1dTpPortInFrames
            |--(4) dot1dTpPortOutFrames
            |--(5) dot1dTpPortInDiscards
|--(5) dot1dStatic
    |--(1) dot1dStaticTable
        |--(1) dot1dStaticEntry
            |--(1) dot1dStaticAddress
            |--(2) dot1dStaticReceivePort
            |--(3) dot1dStaticAllowedToGoTo
            |--(4)  dot1dStaticStatus
|--(6) pBridgeMIB
    |--(1) pBridgeMIBObjects
        |--(1) dot1dExtBase
```

```
        |--(1) dot1dDeviceCapabilities
        |--(2) dot1dTrafficClassesEnabled
        |--(3) dot1dGmrpStatus
        |--(4) dot1dPortCapabilitiesTable
            |--(1) dot1dPortCapabilitiesEntry
                |--(1) dot1dPortCapabilities
    |--(2) dot1dPriority
        |--(1) dot1dPortPriorityTable
            |--(1) dot1dPortPriorityEntry
                |--(1) dot1dPortDefaultUserPriority
                |--(2) dot1dPortNumTrafficClasses
        |--(3) dot1dTrafficClassTable
            |--(1) dot1dPortPriorityEntry
                |--(1) dot1dTrafficClassPriority
                |--(2) dot1dTrafficClass
    |--(3) dot1dGarp
        |--(1) dot1dPortGarpTable
            |--(1) dot1dPortGarpEntry
                |--(1) dot1dPortGarpJoinTime
                |--(2) dot1dPortGarpLeaveTime
                |--(3) dot1dPortGarpLeaveAllTime
        |--(4) dot1Gmrp
        |--(1) dot1dPortGmrpTable
            |--(1) dot1dPortGmrpEntry
                |--(1) dot1dPortGmrpStatus
                |--(2) dot1dPortGmrpFailedRegistrations
                |--(3) dot1dPortGmrpLastPduOrigin
|--(7) qBridgeMIB
    |--(1) qBridgeMIBObjects
        |--(1) dot1qBase
            |--(1) dot1qVlanVersionNumber
            |--(2) dot1qMaxVlanId
            |--(3) dot1qMaxSupportedVlans
```

```
    |--(4) dot1qNumVlans
    |--(5) dot1qGvrpStatus
    |--(2) dot1qTp
    |--(1) dot1qFdbTable
        |--(1) dot1qFdbEntry
            |--(1) dot1qFdbId
            |--(2) dot1qFdbDynamicCount
        |--(2) dot1qTpFdbTable
            |--(1) dot1qTpFdbEntry
                |--(1) dot1qTpFdbAddress
                |--(2) dot1qTpFdbPort
                |--(3) dot1qTpFdbStatus
    |--(3) dot1qTpGroupTable
        |--(1) dot1qTpGroupEntry
            |--(1) dot1qTpGroupAddress
            |--(2) dot1qTpGroupEgressPorts
            |--(3) dot1qTpGroupLearnt
    |--(4) dot1qForwardAllTable
        |--(1) dot1qForwardAllEntry
            |--(1) dot1qForwardAllPorts
            |--(2) dot1qForwardAllStaticPorts
            |--(3) dot1qForwardAllForbiddenPorts
    |--(5) dot1qForwardUnregisteredTable
        |--(1) dot1qForwardUnregisteredEntry
            |--(1) dot1qForwardUnregisteredPorts
            |--(2) dot1qForwardUnregisteredStaticPorts
            |--(3) dot1qForwardUnregisteredForbiddenPorts
|--(3) dot1qStatic
    |--(1) dot1qStaticUnicastTable
        |--(1) dot1qStaticUnicastEntry
            |--(1) dot1qStaticUnicastAddress
            |--(2) dot1qStaticUnicastReceivePort
            |--(3) dot1qStaticUnicastAllowedToGoTo
```

```
        |--(4) dot1qStaticUnicastStatus
|--(2) dot1qStaticMulticastTable
   |--(1) dot1qStaticMulticastEntry
      |--(1) dot1qStaticMulticastAddress
      |--(2) dot1qStaticMulticastReceivePort
      |--(3) dot1qStaticMulticastStaticEgressPorts
      |--(4) dot1qStaticMulticastForbiddenEgressPorts
      |--(5) dot1qStaticMulticastStatus
|--(1) dot1qVlan
|--(1) dot1qVlanNumDeletes
   |--(3) dot1qVlanStaticTable
      |--(1) dot1qVlanStaticEntry
         |--(1) dot1qVlanStaticName
         |--(2) dot1qVlanStaticEgressPorts
         |--(3) dot1qVlanForbiddenEgressPorts
         |--(4) dot1qVlanStaticUntaggedPorts
         |--(5) dot1qVlanStaticRowStatus
|--(5) dot1qPortVlanTable
   |--(1) dot1qPortVlanEntry
      |--(1) dot1qPvid
      |--(2) dot1qPortAcceptableFrameTypes
      |--(3) dot1qPortIngressFiltering
      |--(4) dot1qPortGvrpStatus
      |--(5) dot1qPortGvrpFailedRegistrations
      |--(6) dot1qPortGvrpLastPduOrigin
```

MAU Management Group (1.3.6.1.2.1.26)

The MAU management group is responsible for setting the autonegotiation parameters.

```
(26) snmpDot3MauMgt
   |-- (2) dot3IfMauBasicGroup
   |   |-- (1) ifMauTable
   |       |-- (1) ifMauEntry
   |           |-- (1) ifMauIfIndex
   |           |-- (2) ifMauIndex
   |           |-- (3) ifMauType
   |           |-- (4) ifMauStatus
   |           |-- (5) ifMauMediaAvailable
   |           |-- (6) ifMauMediaAvailableStateExits
   |           |-- (7) ifMauJabberState
   |           |-- (8) ifMauJabberingStateEnters
   |           |-- (9) ifMauFalseCarriers
   |           |-- (10)ifMauTypeList
   |           |-- (11)ifMauDefaultType
   |           |-- (12)ifMauAutoNegSupported
   |-- (5) dot3IfMauAutoNegGroup
   |   |-- (1) ifMauAutoNegTable
   |       |-- (1) ifMauAutoNegEntry
   |           |-- (1) ifMauAutoNegAdminStatus
   |           |-- (2) ifMauAutoNegRemoteSignaling
   |           |-- (4) ifMauAutoNegConfig
   |           |-- (5) ifMauAutoNegCapability
   |           |-- (6) ifMauAutoNegCapAdvertised
   |           |-- (7) ifMauAutoNegCapReceived
   |           |-- (8) ifMauAutoNegRestart
```

Private MIB

Overview

The private MIB is for configuring the device-specific properties of the ESM. The groups below are implemented in the ESM from the private MIB saConfiguration (OID = 1.3.6.1.4.1.3833.1.1.14).

- saChassis (OID = 1.3.6.1.4.1.3833.1.1.14.1)
- saAgent (OID = 1.3.6.1.4.1.3833.1.1.14.2)
- saUserGroup (OID = 1.3.6.1.4.1.3833.1.1.14.3)
- saRingRedundancy (OID = 1.3.6.1.4.1.3833.1.1.14.5)
- saProducts (OID = 1.3.6.1.4.1.3833.1.1.14.10)

Device Group

The device group contains information on the status of the ESM hardware.

```
(14) saConfiguration
  |-- (1) saChassis
  |   |-- (1) saSystemTable
  |       |-- (1) saSysProduct
  |       |-- (2) saSysVersion
  |       |-- (3) saSysGroupCapacity
  |       |-- (4) saSysGroupMap
  |       |-- (5) saSysMaxPowerSupply
  |       |-- (6) saSysMaxFan
  |       |-- (7) saSysGroupModuleCapacity
  |       |-- (8) saSysModulePortCapacity
          |-- (9) saSysGroupTable
              |-- (1) saSysGroupEntry
                  |-- (1) saSysGroupID
                  |-- (2) saSysGroupType
                  |-- (3) saSysGroupDescription
                  |-- (4) saSysGroupHwVersion
                  |-- (5) saSysGroupSwVersion
                  |-- (6) saSysGroupModuleMap
                  |-- (7) saSysGroupAction
                  |-- (8) saSysGroupActionResult
          |-- (11) saInterfaceTable
```

```
                |-- (1) saIfEntry
                  |-- (1) saIfaceGroupID
                  |-- (2) saIfaceID
                  |-- (3) saIfaceStpEnable
                  |-- (4) saIfaceLinkType
                  |-- (5) saIfaceAction
                  |-- (6) saIfaceNextHopMacAddress
                  |-- (7) saIfaceFlowControl
                  |-- (8) saIfacePriorityThreshold
                  |-- (9) saIfaceName
                  |-- (10) saIfaceTrunkID
                  |-- (11) saIfacePrioTOSEnable
                  |-- (12) saIfBcastLimit
                  |-- (13) saIfaceUtilization
                    |-- (14) saIfaceUtilizationControlInterval
            |-- (20) saSysChassisName
            |-- (21) saSysStpEnable
            |-- (22) saSysFlowControl
            |-- (23) saSysBOOTPEnable
            |-- (24) saSysDHCPEnable
            |-- (25) saSysTelnetEnable
            |-- (26) saSysHTTPEnable
            |-- (27) saSysPlugAndPlay
            |-- (29) saBcastLimiterMode
            |-- (30) saSystemTime
    |   |-- (2) saPSTable
    |       |-- (1) saPSEntry
    |           |-- (1) saPSSysID
    |           |-- (2) saPSID
    |           |-- (3) saPSState
      |-- (5) saCurrentAddressTable
            |-- (1) saCurrentAddressEntry
                |-- (1) saCurrentAddress
```

```
            |-- (2) saCurrentAddressReceivePort
            |-- (3) saCurrentAddressStaticEgressPorts
            |-- (4) saCurrentAddressEgressPorts
            |-- (5) saCurrentAddressStatus
|   |-- (10) saESMext
|       |-- (1) saESMOperMode
|       |-- (2) saESMConfigError
|       |-- (3) saESMSigRelayState
|       |-- (4) saSigLinkTable
|               |-- (1) saSigLinkEntry
|               |-- (1) saSigLinkID
|               |-- (2) saSigLinkAlarm
        |-- (5) saSigTrapReason
        |-- (6) saSigReasonIndex
        |-- (7) saESMTopologyGroup
            |-- (1) saESMPartnerIpAddress
            |-- (2) saESMTopologyTable
                |-- (1) saESMTopologyEntry
                    |-- (1) saESMTopologyLinkID
                    |-- (2) saESMTopologyIpAddress
        |-- (9) saESMDisableLearningGroup
            |-- (1) saESMDisableLearningStatus
        |-- (10) saESMSigRelayGroup
            |-- (1) saESMSigRelayMode
            |-- (2) saESMSigRelayManualState
        |-- (11) saESMVlanGroup
            |-- (1) saESMVlanMode
            |-- (2) saESMVlanStatus
        |-- (12) saESMSelftestGroup
            |-- (1) saESMSelftestResult
            |-- (2) saESMSelftestMode
        |-- (13) saESMPSGroup
          |-- (1) saESMPSAlarm
```

Management Group

The management group contains parameters for configuring the management agent.

```
(14)saConfiguration
   |-- (2) saAgent
   |   |-- (1) saAction
   |   |-- (2) saActionResult
   |   |-- (3) saNetwork
   |       |-- (1) saNetLocalIPAddr
   |       |-- (2) saNetLocalPhysAddr
   |       |-- (3) saNetGatewayIPAddr
   |       |-- (4) saNetMask
           |-- (7) saNetAction
           |-- (8) saNetVlanID
           |-- (20) saNetEthernetSwitchConfigurationGroup
               |-- (1) saNetEthernet Switch ConfigurationStatus
               |-- (1) saNetSNTPStatus
               |-- (2) saNetSNTPServer
               |-- (3) saNetSNTPTime
               |-- (4) saNetSNTPLocalOffset
               |-- (5) saNetSNTPServer2
               |-- (6) saNetSNTPSyncInterval
               |-- (7) saNetSNTPAcceptBroadcasts
               |-- (8) saNetSNTPAnycastAddr
               |-- (9) saNetSNTPAnycastVlan
               |-- (10) saNetSNTPAnycastInterval
               |-- (11) saNetSNTPOperStatus
           |-- (50) saNetSNMPGroup
               |-- (1) saNetSNMPv1Status
               |-- (2) saNetSNMPv2Status
               |-- (3) saNetSNMPv3Status
               |-- (4) saNetSNMPAccessStatus
   |   |-- (4) saFSTable
   |       |-- (1) saFSUpdFileName
```

```
|      |-- (2) saFSConfFileName
|      |-- (3) saFSLogFileName
|      |-- (4) saFSUserName
|      |-- (5) saFSTPPassword
|      |-- (6) saFSAction
|      |-- (8) saFSActionResult
       |-- (9) saFSBootConfiguration
       |-- (10) saFSRunningConfiguration
       |-- (200) saBackupConfigGroup
|         |-- (1) saBackupConfigAdapterStatus
|   |-- (5) saTempTable
|      |-- (1) saTemperature
|      |-- (2) saTempUprLimit
|      |-- (3) saTempLwrLimit
|   |-- (7) saAuthGroup
|      |-- (1) saAuthHostTableEntriesMax
|      |-- (2) saAuthCommTableEntriesMax
|      |-- (3) saAuthCommTable
|         |-- (1) saAuthCommEntry
|            |-- (1) saAuthCommIndex
|            |-- (2) saAuthCommName
|            |-- (3) saAuthCommPerm
|            |-- (4) saAuthCommState
|      |-- (4) saAuthHostTable
|         |-- (1) saAuthHostEntry
|            |-- (1) saAuthHostIndex
|            |-- (2) saAuthHostName
|            |-- (3) saAuthHostCommIndex
|            |-- (4) saAuthHostIpAddress
|            |-- (5) saAuthHostIpMask
|            |-- (6) saAuthHostState
|   |-- (8) saTrapGroup
|      |-- (1) saTrapCommTableEntriesMax
```

```
|      |-- (2) saTrapDestTableEntriesMax
|      |-- (3) saTrapCommTable
|         |-- (1) saTrapCommEntry
|            |-- (1) saTrapCommIndex
|            |-- (2) saTrapCommCommIndex
|            |-- (3) saTrapCommColdStart
|            |-- (4) saTrapCommLinkDown
|            |-- (5) saTrapCommLinkUp
|            |-- (6) saTrapCommAuthentication
|            |-- (7) saTrapCommBridge
|            |-- (8) saTrapCommRMON
|            |-- (9) saTrapCommUsergroup
|            |-- (10)saTrapCommDualHoming
|            |-- (11)saTrapCommChassis
|            |-- (12)saTrapCommState
|      |-- (4) saTrapDestTable
|         |-- (1) saTrapDestEntry
|            |-- (1) saTrapDestIndex
|            |-- (2) saTrapDestName
|            |-- (3) saTrapDestCommIndex
|            |-- (4) saTrapDestIpAddress
|            |-- (5) saTrapDestIpMask
|            |-- (6) saTrapDestState
|   |-- (9) saLastAccessGroup
|      |-- (1) saLastIpAddr
|      |-- (2) saLastPort
|      |-- (3) saLastCommunity
|   |-- (10) saMulticast
|     |-- (1) saIGMPGroup
|      |-- (2) saIGMPSnoop
|        |-- (1) saIGMPSnoopStatus
|        |-- (2) saIGMPSnoopUnknownMode
|        |-- (3) saIGMPSnoopAgingTime
```

```
|        |-- (10) saIGMPSnoopQueryTable
|          |-- (1) saIGMPSnoopQueryEntry
|            |-- (1) saIGMPSnoopQueryVlanIndex
|            |-- (2) saIGMPSnoopQueryPorts
|        |-- (11) saIGMPSnoopFilterTable
|          |-- (1) saIGMPSnoopFilterEntry
|            |-- (1) saIGMPSnoopFilterVlanIndex
|            |-- (2) saIGMPSnoopFilterAddress
|        |-- (3) saIGMPSnoopFilterLearntPorts
|        |-- (12) saIGMPSnoopForwardAllTable
|          |-- (1) saIGMPSnoopForwardAllEntry
|            |-- (1) saIGMPSnoopForwardAllVlanIndex
|            |-- (2) saIGMPSnoopForwardAllStaticPorts
|        |-- (13) saIGMPSnoopQueryStaticTable
|          |-- (1) saIGMPSnoopQueryStaticEntry
|            |-- (1) saIGMPSnoopQueryStaticVlanIndex
|            |-- (2) saIGMPSnoopQueryStaticPorts
|        |-- (100) saIGMPQuerierGroup
|          |-- (1) saIGMPQuerierStatus
|          |-- (2) saIGMPQuerierMode
|          |-- (3) saIGMPQuerierTransmitInterval
|          |-- (4) saIGMPQuerierMaxResponseTime
|          |-- (5) saIGMPQuerierProtocolVersion
|      |-- (11) saRelayGroup
|      |-- (1) saRelayOption82Status
|      |-- (2) saRelayOptionRemoteIDType
|      |-- (3) saRelayOptionRemoteID
|      |-- (10) saRelayServerGroup
|        |-- (1) saRelayDHCPServerIpAddr
|        |-- (2) saRelayDHCPServer2IpAddr
|        |-- (3) saRelayDHCPServer3IpAddr
|        |-- (4) saRelayDHCPServer4IpAddr
|      |-- (11) saRelayInterfaceTable
```

```
|        |-- (1) saRelayIfEntry
|           |-- (1) saRelayIfaceGroupID
|           |-- (2) saRelayIfaceID
|           |-- (3) saRelayIfaceOption82Enable
|           |-- (4) saRelayIfaceBCRequestFwd
|     |-- (20) saRelayBCPktInCnt
|     |-- (21) saRelayMCPktInCnt
|     |-- (22) saRelayPktServerRelayCnt
|     |-- (23) saRelayPktClientRelayCnt
|     |-- (24) saRelayErrCnt
|     |-- (25) saRelayLastDuplicateIP
```

User Groups Group

The user groups group contains parameters for configuring the user group functions.

```
(14) saConfiguration
  |-- (3) saUserGroup
    |-- (4) saPortSecurityTable
      |-- (1) saPortSecurityEntry
        |-- (1) saPortSecSlotID
        |-- (2) saPortSecPortID
        |-- (3) saPortSecPermission
        |-- (4) saPortSecAllowedUserID
        |-- (5) saPortSecAllowedGroupIDs
        |-- (6) saPortSecConnectedUserID
        |-- (7) saPortSecAction
        |-- (8) saPortSecAutoReconfigure
```

Redundancy Group

The redundancy group contains parameters for configuring the redundancy functions.

```
(14) saConfiguration
    |-- (5) saRingRedudancy
    |-- (1) saRingRedTable
      |-- (1) saRingRedEntry
        |-- (1) saRingRedPrimGroupID
        |-- (2) saRingRedPrimIfIndex
```

```
            |-- (3) saRingRedPrimIfOpState
            |-- (4) saRingRedRedGroupID
            |-- (5) saRingRedRedIfIndex
            |-- (6) saRingRedRedIfOpState
            |-- (7) saRingRedOperState
            |-- (8) saRingRedMode
            |-- (9) saRingRedConfigOperState
        |-- (2) saRingCouplingTable
          |-- (1) saRingCouplingEntry
            |-- (1) saRingCplInterconnGroupID
            |-- (2) saRingCplInterconnIfIndex
            |-- (3) saRingCplInterconnIfOpState
            |-- (4) saRingCplControlGroupID
            |-- (5) saRingCplControlIfIndex
            |-- (6) saRingCplControlIfOpState
            |-- (7) saRingCplControlMode
            |-- (8) saRingCplPartnerIpAddr
            |-- (9) saRingCplPartnerInterconnGroupID
            |-- (10) saRingCplPartnerInterconnIfIndex
            |-- (11) saRingCplPartnerInterconnIfOpState
            |-- (12) saRingCplOperState
            |-- (13) saRingCplMode
            |-- (14) saRingCplRowStatus
            |-- (15) saRingCplConfigOperState
            |-- (16) saRingCplCouplingLinks
    |-- (10) saProducts
        |-- (2) ESMx7100
```

SNMP V2 Module MIB

Overview

The SNMP V2 Module MIB is based on the SNMP MIB (Simple Network Management Protocol Group).

Framework Group

The framework group contains parameters for describing SNMP Management Frameworks.

```
(3) snmpModules
   |-- (10) snmpFrameworkMIB
   |   |-- (2) snmpFrameworkMIBObjects
   |       |-- (1) snmpEngine
   |           |-- (1) snmpEngineID
   |           |-- (2) snmpEngineBoots
   |           |-- (3) snmpEngineTime
   |           |-- (4) snmpEngineMaxMessageSize
```

MPD Group

The MPD group (Message Processing and Dispatching) contains parameters for dispatching SNMP messages which are potentially in different SNMP versions. It defines the procedures for dispatching potentially multiple versions of SNMP messages.

```
   |-- (3) snmpModules
   |   |-- (11) snmpMPDMIB
   |       |-- (2) snmpMPDMIBObjects
   |           |-- (1) snmpUnknownSecurityModels
   |           |-- (2) snmpInvalidMsgs
   |           |-- (3) snmpUnknownPDUHandlers
```

Target Group

The Target group contains parameters for specifying targets of SNMP management operations.

```
|-- (3) snmpModules
|   |-- (12) snmpTargetMIB
|       |-- (2) snmpTargetObjects
|           |-- (1) snmpTargetSpinLock
|               |-- (2) snmpTargetAddrTable
|                   |-- (1) snmpTargetAddrEntry
|                       |-- (1) snmpTargetAddrName
|                       |-- (2) snmpTargetAddrTDomain
|                       |-- (3) snmpTargetAddrTAddress
|                       |-- (4) snmpTargetAddrTimeout
|                       |-- (5) snmpTargetAddrRetryCount
|                       |-- (6) snmpTargetAddrTagList
|                       |-- (7) snmpTargetAddrParams
|                       |-- (8) snmpTargetAddrStorageType
|                       |-- (9) snmpTargetAddrRowStatus
|           |-- (3) snmpTargetParamsTable
|               |-- (1) snmpTargetParamsEntry
|                   |-- (1) snmpTargetParamsName
|                   |-- (2) snmpTargetParamsMPModel
|                   |-- (3) snmpTargetParamsSecurityModel
|                   |-- (4) snmpTargetParamsSecurityName
|                   |-- (5) snmpTargetParamsSecurityLevel
|                   |-- (6) snmpTargetParamsStorageType
|                   |-- (7) snmpTargetParamsRowStatus
|           |-- (4) snmpUnavailableContexts
|           |-- (5) snmpUnknownContexts
```

Notification Group

The Notification group contains parameters for specifying targets for notification filtering.

```
(3) snmpModules
|-- (13) snmpNotificationMIB
|   |-- (1) snmpNotifyObjects
|       |-- (1) snmpNotifyTable
|           |-- (1) snmpNotifyEntry
|               |-- (1) snmpNotifyName
|               |-- (2) snmpNotifyTag
|               |-- (3) snmpNotifyType
|               |-- (4) snmpNotifyStorageType
|               |-- (5) snmpNotifyRowStatus
|           |-- (2) snmpNotifyFilterProfileTable
|               |-- (1) snmpNotifyFilterProfileEntry
|                   |-- (1) snmpNotifyFilterProfileName
|                   |-- (2) snmpNotifyFilterProfileStorType
|                   |-- (3) snmpNotifyFilterProfileRowStatus
|           |-- (3) snmpNotifyFilterTable
|               |-- (1) snmpNotifyFilterEntry
|               |-- (1) snmpNotifyFilterSubtree
|               |-- (2) snmpNotifyFilterMask
|                   |-- (3) snmpNotifyFilterType
|                   |-- (4) snmpNotifyFilterStorageType
|                   |-- (5) snmpNotifyFilterRowStatus
```

USM Group

The USM group (User-Based Security Model) defines the elements of procedure for providing SNMP message level security.

```
(3) snmpModules
| |-- (15) snmpUsmMIB
|   |-- (1) usmMIBObjects
|       |-- (1) usmStats
|           |-- (1) usmStatsUnsupportedSecLevels
|           |-- (2) usmStatsNotInTimeWindows
|           |-- (3) usmStatsUnknownUserNames
|           |-- (4) usmStatsUnknownEngineIDs
|           |-- (5) usmStatsWrongDigests
|           |-- (6) usmStatsDecryptionErrors
|       |-- (2) usmUser
|           |-- (1) usmUserSpinLock
|               |-- (2) usmUserTable
|       |-- (1) usmUserEntry
|                   |-- (1) usmUserEngineID
|                   |-- (2) usmUserName
|                   |-- (3) usmUserSecurityName
|                   |-- (4) usmUserCloneFrom
|                   |-- (5) usmUserAuthProtocol
|                   |-- (6) usmUserAuthKeyChange
|                   |-- (7) usmUserOwnAuthKeyChange
|                   |-- (8) usmUserPrivProtocol
|                   |-- (9) usmUserPrivKeyChange
|                   |-- (10) usmUserOwnPrivKeyChange
|                   |-- (11) usmUserPublic
|                   |-- (12) usmUserStorageType
|                   |-- (13) usmUserStatus
```

VACM Group

The VACM group (View-based Access Control Model) defines the elements of procedure for controlling access to management information.

```
(3) snmpModules
| |-- (16) snmpVacmMIB
|   |-- (1) vacmMIBObjects
|       |-- (1) vacmContextTable
|           |-- (1) vacmContextEntry
|               |-- (1) vacmContextName
|           |-- (2) vacmSecurityToGroupTable
|               |-- (1) vacmSecurityToGroupEntry
|                   |-- (1) vacmSecurityModel
|                   |-- (2) vacmSecurityName
|                   |-- (3) vacmGroupName
|                   |-- (4) vacmSecurityToGroupStorageType
|                   |-- (5) vacmSecurityToGroupStatus
|           |-- (4) vacmAccessTable
|               |-- (1) vacmAccessEntry
|                   |-- (1) vacmAccessContextPrefix
|                   |-- (2) vacmAccessSecurityModel
|                   |-- (3) vacmAccessSecurityLevel
|                   |-- (4) vacmAccessContextMatch
|                   |-- (5) vacmAccessReadViewName
|                   |-- (6) vacmAccessWriteViewName
|                   |-- (7) vacmAccessNotifyViewName
|                   |-- (8) vacmAccessStorageType
|                   |-- (9) vacmAccessStatus
|           |-- (5) vacmMIBViews
|               |-- (1) vacmViewSpinLock
|               |-- (2) vacmViewTreeFamilyTable
|                   |-- (1) vacmViewTreeFamilyEntry
|                       |-- (1) vacmViewTreeFamilyViewName
|                       |-- (2) vacmViewTreeFamilySubtree
|                       |-- (3) vacmViewTreeFamilyMask
```

```
|          |-- (4) vacmViewTreeFamilyType
|          |-- (5) vacmViewTreeFamilyStorageType
|          |-- (6) vacmViewTreeFamilyStatus
```

RFCs

List of RFCs

The following table contains a list of RFCs:

RFC 768 (UDP)
RFC 783 (TFTP)
RFC 791 (IP)
RFC 792 (ICMP)
RFC 793 (TCP)
RFC 826 (ARP)
RFC 854 (Telnet)
RFC 855 (Telnet Option)
RFC 951 (BOOTP)
RFC 1112 (IGMPv1)
RFC 1155 (SMIv1)
RFC 1157 (SNMPv1)
RFC 1212 (Concise MIB Definitions)
RFC 1213 (MIB2)
RFC 1493 (Dot1d)
RFC 1542 (BOOTP Extensions)
RFC 1643 (Ethernet-Like MIB)
RFC 1757 (RMON)
RFC 1769 (SNTP)
RFC 1867 (HTML/2.0 Forms W/File Upload Extensions)
RFC 1901 (Community-Based SNMP v2)
RFC 1905 (Protocol Operations for SNMP v2)
RFC 1906 (Transport Mappings for SNMP v2)
RFC 1907 (MIB2)
RFC 1908 (Coexistence Between SNMP v1 and SNMP v2)
RFC 1945 (HTTP/1.0)
RFC 2068 (HTTP/1.1)
RFC 2131 (DHCP)
RFC 2132 (DHCP Options)
RFC 2233 (The Interface Group MIB Using SMI v2)
RFC 2236 (IGMPv2)

RFC 2239 (MAU MIB)
RFC 2246 (The TLs Protocol, Version 1.0)
RFC 2271 (SNMP Framework MIB)
RFC 2346 (AES Ciphersuites for Transport Layer Security)
RFC 2570 (Introduction to SNMP v3)
RFC 2571 (SNMP Framework)
RFC 2572 (SNMP MPD)
RFC 2573 (SNMP Applications)
RFC 2574 (SNMP USM)
RFC 2575 (SNMP VACM)
RFC 2576 (Coexistence Between SNMP v1, v2 and v3)
RFC 2578 (SMI v2)
RFC 2579 (Textual Conventions for SMI v2)
RFC 2580 (Conformance Statements for SMI v2)
RFC 2613 (SMON)
RFC 2618 (RADIUS Authentication Client MIB)
RFC 2620 (RADIUS Accounting MIB)
RFC 2674 (Dot1p/Q)
RFC 2818 (HTTP over TLs)
RFC 2851 (Internet Addresses MIB)
RFC 2865 (RADIUS Client)
RFC 2866 (RADIUS Accounting)
RFC 2868 (RADIUS Attributes for Tunnel Protocol Support)
RFC 2869 (RADIUS Extensions)
RFC 2869 (RADIUS Support for EAP)
RFC 2933 (IGMP MIB)

IEEE Standards

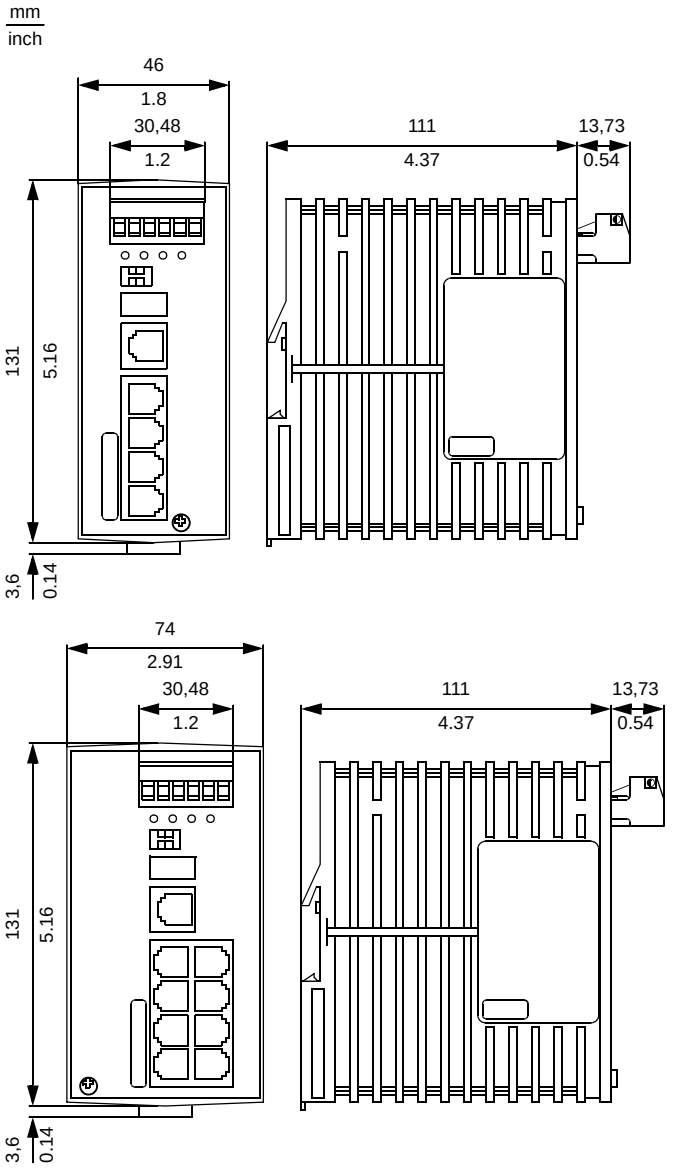
List of IEEE Standards

The following table lists the IEEE standards applying to the ESM.

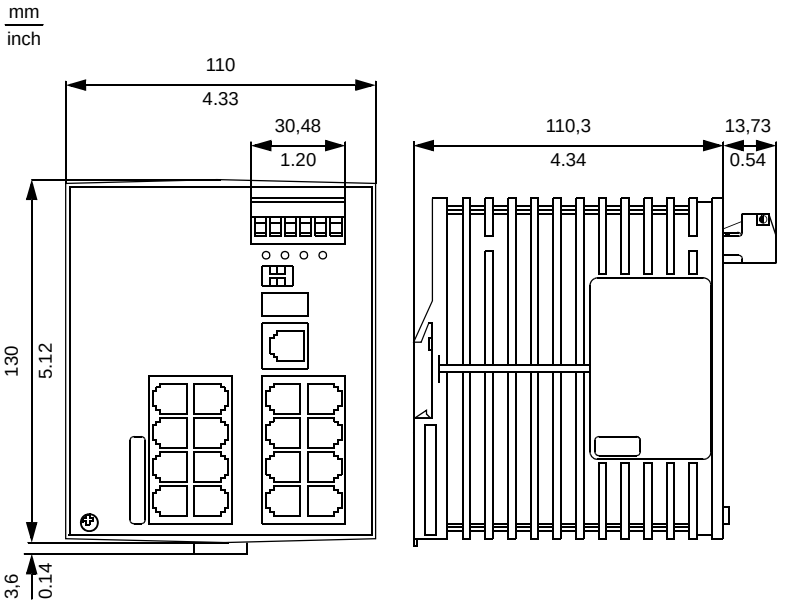
Standard	Explanation
IEEE 802.1 D	Switching, GARP, GMRP, Spanning Tree (supported via 802.1S implementation
IEEE 802.1 D-1998	Media Access Control (MAC) bridges (includes IEEE 802.1p Priority Dynamic and Multicast Filtering, GARP, GMRP)
IEEE 802.1 Q-1998	Virtual Bridged Local Area Networks (VLAN Tagging, port-based VLANs, GVRP)
IEEE 802.1 S	Multiple Spanning Tree
IEEE 802.1 v	Protocol-Based VLANs
IEEE 802.1 w.2001	Rapid Reconfiguration, supported via 802.1S implementation
IEEE 802.1 X	Port Authentication
IEEE 802.3 - 2002	Ethernet
IEEE 802.3 ac	VLAN Tagging
IEEE 802.3 ad	Link Aggregation with static LAG and LACP Support
IEEE 802.1 X	Port Authentication
IEEE 802.3 x	Flow Control

Dimension Drawings

4 and 8 Port Versions



16 and 24 Port Versions



The Two-Pin DIP Switch Settings

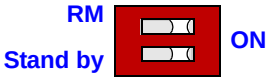
The Two-Pin DIP Switch

The settings of the two-pin DIP switch, located on the front of the TCSESM switch, determines which of the following modes the switch is in:

- HIPER-Ring Redundancy Mode
- HIPER-Ring Redundancy Manager Mode
- Standby Mode
- Software Mode

The DIP switch setting combinations are described below

The figure shows the DIP switch with both switches in the **ON** position.



DIP Switch Settings

The table shows the various DIP switch settings you can make and what modes each pair of settings represent.

DIP Switches		ESM Operation Mode	Default ESM Firmware Settings				
RM	**Stand-By**		**HIPER-Ring**	**Redundancy Manager**	**Ring Ports**	**Ring Coupling**	**Coupling Port**
OFF	OFF	HIPER-Ring Redundancy Mode	ON	OFF	1 & 2	ON	4
ON	OFF	HIPER-Ring Redundancy Manager Mode	ON	ON	1 & 2	ON	4
OFF	ON	Standby Mode (HIPER-Ring Coupling, or Network Coupling)	ON	ON	1 & 2	ON	4
ON	ON	Software Mode-Use Web or CLI to configure MRP or RSTP Software Mode-Use Web or CLI to configure MRP Coupling or Network coupling	OFF	OFF			

General Technical Software Data

ESM

The following table shows the technical data of the ESM.

Switch	Data
Latency - 1000 MBit/s	 max. 3.5 µs
- 100 MBit/s	max. 4.5 µs
- 100 MBit/s	max. 19 µs
MAC address table	up to 8000 entries
Static Address Filter	up to 100 entries (in RM (redundancy manager) mode: 0 unicast entries

VLAN

The following table shows the VLAN-related technical data of the ESM.

VLAN	Data
VLAN ID	1 to 4062
Number of VLANs	max. 256 simultaneously per switch
Number of VLANs	max. 256 simultaneously per port
Number of VLANs with GMRP (VLAN 1)	max. 256 simultaneously per switch
Number of VLANs with GMRP (VLAN 1)	max. 256 simultaneously per port

Switches and Accessories

Scope of Delivery

The delivery comprises:

- selected switch version
- terminal block for supply voltage and signal contact
- description and manuals
- CD ROM

Order Numbers

Part Number		Description
4 Port Version	TCSESM043F23F0	4 10/100 TX Managed
	TCSESM043F1CU0	3 10/100 TX 1 100 FX-MM Managed
	TCSESM043F2CU0	2 10/100 TX 2 100 FX-MM Managed
	TCSESM043F1CS0	3 10/100 TX 1 100 FX-SM Managed
	TCSESM043F2CS0	2 10/100 TX 2 100 FX-SM Managed
8 Port Version	TCSESM083F23F0	8 10/100 TX Managed
	TCSESM083F1CU0	7 10/100 TX 1 100 FX-MM Managed
	TCSESM083F2CU0	6 10/100 TX 2 100 FX-MM Managed
	TCSESM083F1CS0	7 10/100 TX 1 100 FX-SM Managed
	TCSESM083F2CS0	6 10/100 TX 2 100 FX-SM Managed
	TCSESM083F2CX0	6 10/100 TX 1 100 FX-MM 1 100 FX-SM Managed
16 Port Version	TCSESM163F23F0	16 10/100 TX Managed
	TCSESM163F2CU0	14 10/100 TX 2 100 FX-MM Managed
24 Port Version	TCSESM243F2CU0	22 10/100 TX 2 100 FX-MM Managed
Gigabit - 10 Port Version	TCSESM103F23G0	8 10/100 TX 2 10/100/1000 TX Managed
	TCSESM103F2LG0	8 10/100 TX 2 1000 SFP (fiber) Managed **Note:** These products ship with open sockets (SFP) on the fiber ports, so in order to use these ports, you must order 1, or 2, media modules shown below.
Fiber Media Modules	TCSEAAF1LFU00	SFP-SX/LC fiber module for Gigabit
	TCSEAAF1LFS00	SFP-LX/LC fiber module for Gigabit
	TCSEAAF1LFH00	SFP-LH/LC fiber module for Gigabit
Accessories	TCSEAM0100	Memory Backup Adapter

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Version 2.1, February 1999

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```
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library `Frob' (a library for tweaking knobs) written by James
Random Hacker.

<signature of Ty Coon>, 1 April 1990

Ty Coon, President of Vice
```

That's all there is to it!

The Legion Of The Bouncy Castle

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Switch Function Examples

B

Setting Up the DHCP Server for Option 82

Introduction

The procedure for setting up a DHCP server for Option 82 is described on the following pages. Prior to performing that procedure, read the following safety warning and be aware of the consequences that can result from changing the existing port connections on the ESM switch.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

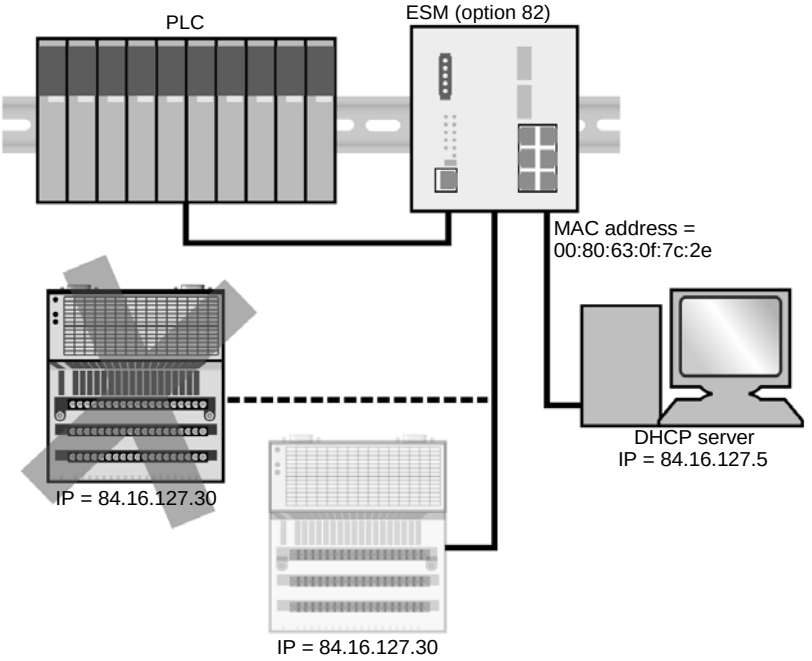
If IP addresses are assigned using DHCP option 82, changing the port to which a device is connected will cause its IP address to change.

- Do not change device port connections on the ESM.
- When performing maintenance on an ESM, make sure to label each Ethernet cable with the ESM port number assigned so that you can reestablish the same configuration.

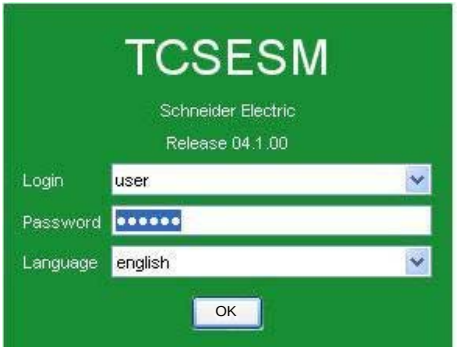
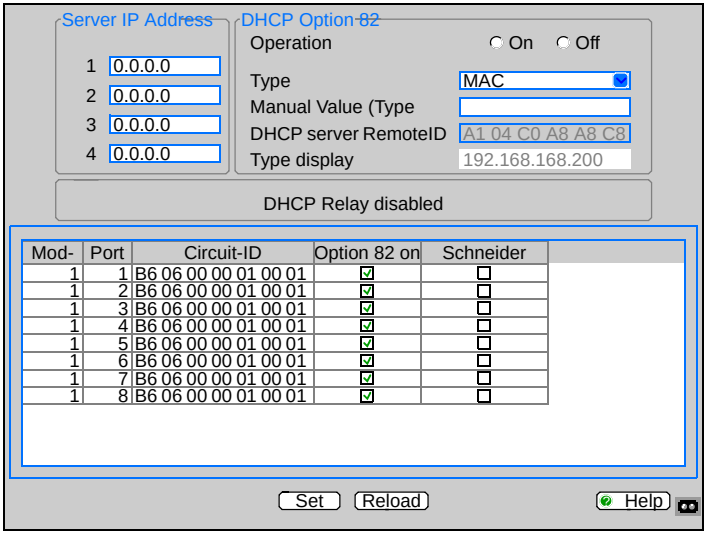
Failure to follow these instructions can result in death, serious injury, or equipment damage.

Option 82 Application Example

DHCP option 82 allows you to assign the same IP address to any device connected to a particular switch port. The server shown in the example below must support option 82.



Configuring a Switch for DHCP Option 82

Step	Action
1	Log in to the Web-based interface (*p. 14*). 
2	Go to Advanced → DHCP Relay Agent. 
3	In line **1** of the Server IP Address group box, enter the DHCP server's IP address.
4	In the Operation line of the DHCP Option 82 group box, select On.
5	Choose MAC from the drop-down list in the Type line.
6	Click Set to save the configuration.

DHCP Option 82 Server Hardware Address

DHCP option 82 servers require that you input a hardware address. This address consists of the switch's remote ID and circuit ID. The circuit ID identifies the port on the switch where the device to which you want to assign an IP address is connected.

The addresses of remote ID and circuit ID are shown on the DHCP Relay Agent web page, which is shown in step 2 of the procedure above. In the screen above, the remote ID is `A104C0A8A8C8`. If the device is connected to port 7 of the switch, then the circuit ID is `B606000001000107`.

Note: One tool you may use to set up DHCP server option 82 on your PC is haneWIN, which can be downloaded from the www.hanewin.de website. You may elect to use other appropriate software, like those included with Windows 2000 servers or Linux operating systems.
The haneWIN software can be tested for 30 calendar days from the date of the first installation before deciding whether you want to purchase a license. Schneider Electric does not guarantee in any way that the product will function as described and disclaims any responsibility for damages that may result from its use.

TFTP Server for Software Updates

Switch Software

The ESM software is in the flash memory by default. The ESM boots the software from the flash memory.

Software updates can be realized via a tftp server. This presupposes that a tftp server has been installed in the connected network and that it is active.

Note: An alternative to the tftp update is the http update. If you perform an http update you do not have to configure the tftp server.

The ESM requires the following information for updating software from the tftp server:

- its own IP address (entered permanently),
- the IP address of the tftp server or gateway to the tftp server,
- the path in which the operating system of the tftp server is located.

File transfer between the ESM and the tftp server is handled by way of the Trivial File Transfer Protocol (tftp).

Management station and tftp server may be made up of one or more computers.

Preparation of the tftp server for the ESM software involves:

- setting up the ESM directories and copying ESM software,
- setting up the tftp process.

Prerequisites for Setting Up the TFTP Process

The general prerequisites for setting up the tftp process are the following:

- The ESM knows its local IP address and the IP address of tftp server/gateway.
- The TCP/IP stack and tftp are installed on the tftp server.

Setting up the TFTP Process

The following table shows the steps for setting up the tftp process, with subsequent tables providing a breakdown according to operating system and application.

Step	Action	Comment
1	Check if the tftp daemon (background process) is running.	Check whether the file `etc/inetd.conf` contains the following line: ● in SunOS `tftp dgram udp wait root /usr/etc/in.tftpd in.tftpd -s /tftpboot`, ● in HP tftp dgram udp wait root /usr/etc/in.tftpd tftpd.
2	Check whether the status of this process is **IW**.	The status should be **IW**.
3	If the process is not in the file, or if the related line is commented out (#), modify `etc/inetd.conf` accordingly.	
4	Enter the UNIX command `man tftp`.	

The command `ps` does not always show the tftp daemon, although it is actually running.

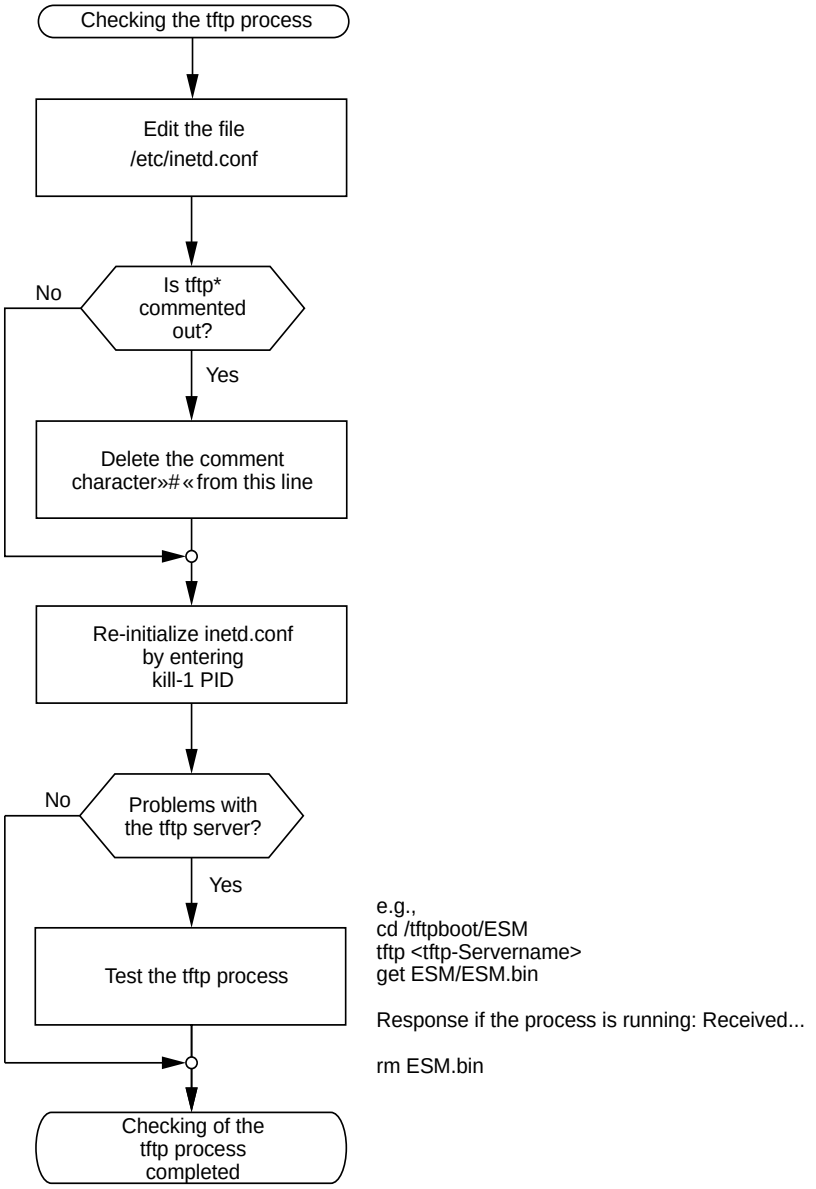
Tftp Installation on HP Workstations

The following table describes the special steps to be taken when installing tftp on HP workstations.

Step	Action	Comment
1	Enter the user tftp in the file `/etc/passwd`.	For example: *tftp*:*:*510*:*20*:*tftp server*:/usr/tftpdir:/*bin/false* Where: *tftp* = user ID * = in the password field *510* = sample user ID *20* = sample group ID *tftp server* = reely selectable designation */bin/false* = mandatory entry (login shell).
2	Test the tftp process.	For example: cd /tftpboot/ESM tftp <tftp-Servername> get ESM/ESM.bin rm ESM.bin.

Flowchart for Setup

The following flowchart summarizes the procedure for setting up the tftp server with SunOS and HP.



* tftp dgram udp wait root/usr/etc/in.tftpd in.tftpd /tftpboot

Software Access Rights

The agent needs read permission to the tftp directory with the ESM software.

Directory Structure of the Software

The following table shows the directory structure of the tftp server with stated access rights, once the ESM software has been installed.

Filename	Access
TCSESM.xxxxx.bin	444-r--r--r-

d = directory; r = read; w = write; x = execute

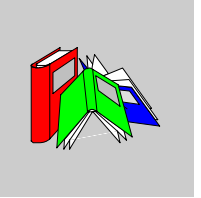
1st position designates d (directory)

2nd to 4th positions designate access rights of user

5th to 7th positions designate access rights of user groups

8th to 10th positions designate access rights of all others.

Glossary



D

DHCP *Dynamic Host Configuration Protocol*. A protocol used by networked devices (clients) to obtain the parameters necessary for operation in an IP network. It reduces system administration workload, allowing devices to be added to the network with little or no manual configurations.

DSCP *DiffServ Code Point*. A networking architecture that specifies a simple, scalable and coarse-grained mechanism for classifying, managing network traffic and providing Quality of Service guarantees on modern IP networks.

E

EAM *Memory back up adapter*. A USB device which stores the configuration data of the ESM switch. If the switch becomes inoperative, the configuration data can be easily transferred to another switch.

F

FDB *forwarding database*, which stores addresses (MAC addresses or network addresses) against the relevant forwarding data (that is, port numbers).

G

GARP *General Attribute Registration Protocol*. A standard for registering a client station into a multicast domain. GARP is an industry-standard protocol defined by IEEE 802.1P.

GMRP *GARP Multicast Registration Protocol*. A General Attribute Registration Protocol application that provides a constrained multicast flooding facility. GMRP is an industry-standard protocol defined by IEEE 802.1P.

I

ICMP *Internet Control Message Protocol*. TCP/IP protocol used to send status and control messages. For example, a router uses ICMP to notify the sender that its destination node is not available.

IGMP *Internet Group Management Protocol*. A protocol that governs the management of multicast groups in a TCP/IP network.

L

LLDP *Link Layer Discovery Protocol*. A protocol that provides a method for switches, routers and access points to advertise their identification, configuration and capabilities to neighboring devices that store the data in a MIB (management information base).

N

NTP *Network Time Protocol*. Used to update the real time clock in a computer. There are numerous primary and secondary servers in the Internet that are synchronized to the international time standard Coordinated Universal Time (UTC) via radio, satellite or modem.

Q

QoS *Quality of Service*. A function that identifies high-priority time-critical data traffic such as language/video or real-time data and reduces possible disruptions caused by less critical traffic during busy network periods.

R

RFC *Request For Comment*. A document that describes the specifications for a recommended technology. RFCs are used by the Internet Engineering Task Force (IETF) and other standards bodies.

RM *Redundancy Manager*. A switch function which allows you to close both ends of a backbone in a line-type configuration to create a redundant HIPER ring.

RSTP *Rapid Spanning Tree protocol*. A protocol that provides a loop free topology for any LAN (Local Area Network) or bridged network.

S

SFP *Small Form Factor Pluggable* interface. An industry standard daughter card used in networking. Its main advantage is that new speeds can be interfaced to an expensive network device by changing only the SFP card.

T

TFTP *Trivial Transfer File Protocol*. A version of the TCP/IP FTP protocol that has no directory or password capability.

V

VLAN *Virtual Local Area Network*. A logical subgroup within a local area network that is created via software rather than manually moving cables in the wiring closet.

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